This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

HARVARD
MEDICAL LIBRARY

IN THE
Francis A. Countway
Library of Medicine
BOSTON

TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERV

PUBLIC HEALTH BULLETIN No. 121

MAY, 1922

RODENT INFESTATION AND RAT-PRO CONDITIONS IN MASSACHUSETTS SEA CITIES, NEW YORK CITY, AND BALTIMORE

By

Passed Assistant Surgeon LOUIS L. WILLIAMS, Jr
United States Public Health Service, and J. C. MOS
MAN, Massachusetts State Department of Health

Junior Assistant Sanitary Engineer E. C. SULLIVAN
under the supervision of Associate Sanitary Enginee
SOL PINCUS, United States Public Health Servic

Associate Sanitary Engineer A. F. ALLEN, Unite
States Public Health Service

Prepared by Direction of
THE SURGEON GENERAL

WASHINGTON
GOVERNMENT PRINTING OFFICE
1922

TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 121

MAY, 1922

RODENT INFESTATION AND RAT-PROOFING CONDITIONS IN MASSACHUSETTS SEACOAST CITIES, NEW YORK CITY, AND BALTIMORE

By

Passed Assistant Surgeon LOUIS L. WILLIAMS, Jr., United States Public Health Service, and J. C. MOSMAN, Massachusetts State Department of Health

Junior Assistant Sanitary Engineer E. C. SULLIVAN, under the supervision of Associate Sanitary Engineer SOL PINCUS, United States Public Health Service

Associate Sanitary Engineer A. F. ALLEN, United States Public Health Service

Prepared by Direction of
THE SURGEON GENERAL

WASHINGTON
GOVERNMENT PRINTING OFFICE
1922

TABLE OF CONTENTS.

Page.

liminary report on proposed antiplague measures in Massachusetts 1
- Boston 1
- Roxbury 2
- South Boston 2
- Charlestown 3
- East Boston 3
- Chelsea 3
- Lynn and East Lynn 4
- Salem 4
- Beverly 4
- Danvers 5
- Peabody 5
- Newburyport 5
- Gloucester 5
- New Bedford 6
- Fairhaven 6
- Fall River 6
- Buzzards Bay 7
- Quincy 7
- Plymouth 7
- Summary 8
- An ordnance compelling the placing of rat guards 8
- An ordinance regulating the removal of garbage 9
- An ordinance defininining rat proofing of all buildings 11

Preliminary report on the rat-proofing status of the New York water front with suggested methods of improving conditions 15
- Purpose 15
- Introduction 15
- General information 16
- General conditions 16
- Type of docks 17
- Substructure 18
- Superstructure 19
- Special considerations 21
- Summary 21

A report of an investigation of the rodent infestation and rat-proofing condition of the city of Baltimore, Md 23
- Extent of rodent infection 26
- Control in general of rodent infestation 27
- Determination of the presence of plague 29
- Study of the conditions of building with reference to rat proofing 30
- Wharf construction 31
- Study of present building code 32
- The proposed building code 34
- Discussion of building codes 37
- Recommendations regarding the building codes 37
- Provision for rat-proofing enforcement 38
- Summary of finding and recommendations 38

ILLUSTRATION.

Plague-infected ports since 1894 24

PRELIMINARY REPORT ON PROPOSED ANTIPLAGUE MEASURES IN MASSACHUSETTS.

By LOUIS L. WILLIAMS, Jr., Passed Assistant Surgeon, United States Public Health Service, and H. C. MOSMAN, Massachusetts State Department of Health.

In the State of Massachusetts there are 16 municipalities with water fronts that are used in part for purposes of shipping. This does not include those municipalities on the coast whose harbors are not sufficiently deep for other than very small craft nor extinct ports, such as Barnstable, Falmouth, and Yarmouth, where the harbors have been allowed to fill up.

This survey makes no attempt at the estimation of the rodent population. Those places where it seemed probable that the heaviest infestation with rodents would be found were examined and an estimate made as to the extent and location of those sections that should be trapped in the making of a rat survey and the time that would probably be consumed in the making of such a survey. In calculating a time for trapping each community, estimate was based on a force consisting of one foreman and five trappers, each trapper using 150 to 200 traps.

In all cases it seemed probable that the heaviest rat infestation was along the water front and, considering that here is where plague infection would be introduced, that rat catching if confined almost entirely to the various water fronts would yield the best information as to present conditions in each community.

Therefore, for the purposes of this report, only a bird's-eye view of the water front of each community considered will be given, with the time necessary to trap; approximate number of rats advisable to examine; the prevailing type of dock, dock superstructure, and adjacent buildings (with special reference to rat harborage and food supply); and tentative ordinances that should be enforced in each community.

Boston.—Population, 748,060. Boston is the main seaport of New England. Its water front comprises 6 areas of Boston proper (Roxbury, Boston proper, South Boston, Cambridge, Charlestown, and East Boston), with the two adjacent communities of Chelsea and Everett.

In Boston proper we find the shipping area, with its type of construction, as follows: From Warren Bridge and Commercial Street east to Atlantic Avenue, about one-half mile, mostly construction docks and light wharves for coastwise shipping. Atlantic Avenue from Commercial Street to South Station, about 1¼ miles, very congested shipping, comprising coastwise shipping, coal docks, excursion, passenger, and freight wharves.

These docks are practically all of old wooden construction, with wooden superstructures, offering excellent harborage for rats. Along the water front, and in close proximity to the docks, are a great many food warehouses, cold-storage and packing plants, and many grocery stores and restaurants. These offer abundant food of easy access to the rats, of which there are many signs of an extremely heavy infestation. Very few of the buildings in this section are rat proof.

It is estimated that an index of the rat situation along this water front should include the examination of between 20,000 and 30,000 rats. These could easily be secured along the docks and those large buildings and warehouses within two or three blocks of the docks themselves. This would require between six and eight months.

Roxbury.—The water front of this section is found along Fort Point Channel and South Bay up to Batchelder Bros.' coal wharf at Southampton Street, about 1½ miles. The dockage is sparse, except in the South Bay section, where there are many docks for lumber and coal. These docks are all of wood, with wooden superstructures. The near-by buildings are mostly old wooden structures, many of them food depots and lumber yards. All offer excellent rat harborage close to abundant food supply. The New York, New Haven & Hartford Railroad have a large railroad freight yard near by.

Trapping this area would require about one and one-half months, yielding for examination between 4,000 and 5,000 rats.

South Boston.—The water front of South Boston is found on the eastern side of Fort Point Channel and South Bay, as well as Boston Harbor on the north. There are no docks on South Bay. Along Fort Point Channel is a large coal dock and a pier for a large sugar refining company. Large boats dock here from Cuba, Porto Rico, and Gulf ports. Both harborage and abundant food supply for rats are found at this place. On the Boston Harbor side is a large Government dock (Army supply base), Boston Fish Pier, and Commonwealth Pier. These are all of concrete construction and are practically rat proof throughout. There are no nonrat-proof buildings close to these piers, other than the freight warehouse of the New York, New Haven & Hartford Railroad, about 200 yards distant. To some of these piers come large boats from all ports of the world. In addition to the above-mentioned docks, and closer to Boston proper, are found coal and general freight piers, docks for coastwise shipping, and small wharves. Most of the construction of these last mentioned is very old, mostly wooden, and offers abundant harborage for rats.

Trapping of this area would require about two months and yield between 5,000 and 6,000 rats.

From South Boston on the eastern water front comprising Pleasure Bay, Old Harbor, Dorchester Bay, and Neponset River no shipping other than very small craft is found until Neponset is reached. Here are a few lumber and coal wharves. These are of old construction, wooden, excellent rat harbors, and there is a fairly abundant food supply near by in the shape of many groceries and restaurants.

Trapping of Neponset would require about one-half month, with a yield of about 1,200 to 1,500 rats.

Charlestown.—The eastern water front of Charlestown is largely taken up by the navy yard. South of the navy yard are found a few docks comprising the Savannah Line and part of the Boston & Maine system. North of the navy yard are many coal docks and a few large grain elevators. These docks and their superstructures are of wood, offering both excellent harborage and abundant food for a large rodent population. The northern, or Mystic River, water front is taken up by the Boston & Maine freight yard and docks. These docks are mostly for coal and grain and afford excellent harborage and food supply.

Trapping here would require about three months and yield between 8,000 and 10,000 rats.

East Boston.—The docks and water front of East Boston are very congested. They are mostly very old and are entirely of wood with old wooden superstructures. There are a large number of warehouses and storage sheds in close proximity to the docks. Nesting, harborage, and food supply for rats are easy of access and in great abundance. Along Marginal Street on the south front are found the Clyde, Cunard, and Boston & Albany Docks and the large Boston and Maine elevator with shipping from all parts of the world. Along Meridian Street (eastern water front) are found closely packed small docks and many machine shops with a few grain elevators interspersed. Along Condor Street (northern or Chelsea side) are old dilapidated docks, many wooden barges and dredges, and a large oil tank pier and reservation.

Trapping this area would require about six months and would yield between 15,000 and 20,000 rodents. This is one of the most important areas of Boston requiring examination.

Chelsea.—Population, 43,184; area approximately 3 square miles; water front about 3 miles long.

Chelsea may be described as a city with two water fronts, one on the southeast, the other along the west side. Inspection of these areas shows that on the southeast the water front is practically a continuous collection of warehouses, docks, dry docks, and machine shops. These are of old construction, many of them wood throughout; all are of defective construction, and apparently extremely good rat harbors. No investigation was made at this time as to the presence of rats. Opportunity for their ingress from the boats was excellent, harborage is of the best, and nonprotected food depots are abundant and close.

The other water front is not so congested, but of a fairly similar type, with a preponderance of machine shops.

Trapping of Chelsea would require about two months and should yield for examination between 5,000 and 6,000 rats.

Lynn and East Lynn.—Population, 99,143. Lynn is situated about 10 miles north of Boston. The water front is small and very congested. There are numerous coal, lumber, and utility docks. In close proximity to the water front is a large grain elevator. The docks are old, wooden, many incased in sheet piling, with many old wooden superstructures thereon. Food stores are found in abundance close to the docks, thickly interspersed among old and often dilapidated houses, sheds, and shops. Rat proofing is conspicuously absent. Rat harborage is extremely abundant and in close proximity to easy food supply.

Trapping this community would require about one month and should yield between 2,500 and 3,000 rats. The rat survey here should not only comprise the water front, but should extend back into the town for at least five blocks from the water front in the congested part of the community.

Salem.—Population, 42,529. Salem is situated north from Boston about 15 miles. The water front of this town is about 2 miles long, of which only about one-half mile is used for dock purposes. These docks are mainly used for coal, lumber, and hides. The type of construction is old, of wood throughout, with many dilapidated wooden superstructures. Housing along the water front is very congested and of old construction, much of it wooden. On the water front are found many large meat-storage plants; hide and leather factories abut on the water front and are also scattered throughout most sections of the town. Freight yard and freight houses are close by the water front. A very large number of the structures throughout the water front are old and dilapidated. Rat harborage and goodly food supply are excellent.

The trapping time of this place should not require over six weeks, and the catch should be concentrated from the rather limited dockage front and the adjacent houses and near-by factories. The yield should be about 4,000 rats.

Beverly.—Population, 22,561. Beverly is situated close to Salem, separated only by a narrow inlet. Its water front stretches out for the most part on the north shore of Salem Harbor. This town is connected with Salem by a large bridge and as a community really forms part of Salem. The water front of Beverly is about 1½ miles long along Beverly Harbor (a small bay off Salem Harbor) and North River. On the harbor side is found a large oil tank reservation and dock; many coal and leather docks and warehouses, machine and junk shops. Across the narrow street which parallels the water front are numerous wooden houses (of old construction, many dilapidated), junk shops, hay barns, and fish markets. This is an ideal rat location. Up North River, as far as Danvers, are found numerous isolated coal and lumber docks. Near by are many grain elevators. hide warehouses, and shoe factories.

Trapping in Beverly would be for the most part concentrated on the harbor water front with a few trapping expeditions to various grain elevators and shoe factories. Time spent here should be about five weeks and yield about 3,500 rats.

Danvers.—Population 11,108. Danvers is situated from Salem northwest about 4 miles. This is a scattered town of shoe factories more or less spread out along North River continuing the conditions found up North River from Beverly. Trapping time in this place should consume not over three weeks for a total of about 1,500 rats.

Peabody.—Population 19,552. Peabody is a small town almost continuous with Salem, about 2 miles west of the city proper. There is no true water front found in this place, but a small canal reaches in nearly to the town. This town is similar in activities to Salem with rather similar conditions excepting the water front. It would be necessary to trap this town in conjunction with Salem, giving about three weeks for a total of about 1,500 rats.

Newburyport.—Population 15,618. Newburyport is situated north from Boston about 35 miles. It lies on the south shore of the Merrimac River about 6 miles from its mouth. The water front is about 1 mile long, showing a number of very old coal docks with dilapidated wooden superstructures. Along the water front are many coal yards, some lumber yards, a few provision warehouses (not much used) and one meat storage depot.

Shipping is very sparse, most of it being coal barges. The water front of Newburyport is not very congested, and considering the lack of shipping, the trapping time should not be much over two weeks for a total of 1,000 to 1,500 rats.

Gloucester.—Population 22,947; situated northeast from Boston about 30 miles. The water front of Gloucester is semicircular, arranged along the inner side of a land locked harbor. The dockage front is about 2 miles long. The docks and adjacent buildings are extremely congested. The docks are of old wooden construction with many wooden superstructures. They are mostly used as fish docks, some coal docks, machine shops, and dry docks. There are many feed houses close to the water front. Rodent harborage is abundant and food supply is very abundant and easy of access. Practically all of the shipping from this port is that of local fishing boats with some coal and lumber.

The trapping time in Gloucester should extend for about two months for a yield of between 5,000 and 6,000 rats.

New Bedford.—Population, 121,217. New Bedford is situated south from Boston about 50 miles, fronting on the west shore of the Acushnet River a little above its entrance into Buzzards Bay. The water front is very long, as is the city (built on a long, narrow peninsula), with navigable water on the river side only. The dockage front is very short and congested, being found from the Fairhaven bridge south for only about one-half mile. Along this stretch are found many lumber and coal yards, cotton docks, and general merchandise and oil docks. Almost all are of old wooden construction, with food and fish houses very near. Among these old wooden docks is found one excellent rat-proof structure, a State pier of concrete construction. With the exception of this dock all offer excellent harborage for rats, as do the houses neighboring on the water front, they being for the most part very old, mostly of wood and frequently with wooden foundations. In this city are found many cotton mills. A large number of these are on the water front. These mills, however, are of masonry construction. No detailed inspection or search for rats was made, but they appear to be practically rat proof throughout, and it is doubtful if many rats are to be found herein.

Fairhaven.—This is a small town across the river from New Bedford, being connected thereto by one large bridge. On the Fairhaven side are a few coal docks across the way from the dockage area of New Bedford. It would be well to trap Fairhaven in conjunction with New Bedford.

The trapping time for New Bedford should require about six weeks, that for Fairhaven from one to two weeks, or about two months in all, yielding a catch of about 6,000 rodents.

Fall River.—Population, 120,485. Fall River is situated from Boston south about 45 miles. The city is set on the shores of Mount Hope Bay, an inlet off Narragansett Bay. The water front is long but only a small portion is used for dockage. This is found extending from the railroad bridge south for about 1 mile. In this section are found many docks, compact and congested. From this point south for about three-quarters of a mile there is found but one large coal and oil dock. North of the railroad bridge there is a small agglutination consisting of three small, old piers and one large modern oil pier connected with a large oil-tank reservation. In the city and especially on the water front are found many cotton mills. These are for the most part of very old construction, but are masonry throughout. They do not appear to be particularly good rat harbors. The dockage proper is about in the center of the water front. The docks are old and wooden, with wooden superstructures upon many. The surrounding area is extremely congested, abounding in warehouses and food establishments. This section seems to offer extremely good rat harborage with abundant food supply.

The trapping time would require about nine weeks and should yield between 6,500 and 7,500 rats.

Buzzards Bay.—Population about 500. Buzzards Bay is situated about 15 miles east of New Bedford. This is a very small town, mostly filled with summer homes. The only shipping found here is that of coal barges. However, many ships at this point pass into Cape Cod Canal, not using Buzzards Bay as a stopping point. At the north end of Cape Cod Canal is found Sandwich. This town is even smaller than Buzzards Bay, but somewhat similar in type as to shipping, the only dockage being coal barges. Considering the dissemination of rodents from port to port by means of barges, it would be well to trap both Buzzards Bay and Sandwich, allowing about one week for each place, or two weeks in all for a yield of approximately 1,500 rats.

Quincy.—Population, 47,876. Quincy is situated from Boston southeast about 10 miles on Boston Bay. The water front is in the form of a peninsula between Town River Bay and Fore River. At the point of the peninsula extends the bridge to Weymouth. From this bridge south are found the Fore River Ship Yards. This is a very large shipbuilding corporation, which also does extensive ship repairs on boats from many different points. Near these shipyards are found a few coal docks and one oil dock. The housing and warehousing surrounding the shipyards and the above-mentioned docks is not congested, and this area, although offering average harborage, and perhaps adequate food, probably does not support as large a rodent population as most of the other ports. From the Weymouth Bridge northwest, up Town River Bay, is found only one coal dock and a yacht basin. This last is sometimes used as a small naval station.

The trapping time for the Quincy water front should not be over three to four weeks for a yield of about 1,500 rats.

Plymouth.—Population, 13,045. Plymouth, fronting on Cape Cod Bay, is situated southeast from Boston about 35 miles. This is a small rambling town stretching thinly along its water front. The dockage area is very small and is near the center of the town. Of all its former docks, there are now but eight in use, and these for coal, lumber, and fish. On the southern end of the water front are found a few coal wharves. A few warehouses and many buildings of the town are very close to the water front. These are of very old construction, mostly wooden. There are many food depots along the water front. This area offers abundant food and excellent harborage for rats.

Trapping time for Plymouth would require about four weeks for a catch of between 5,000 and 6,000 rats.

SUMMARY.

Judging from the survey made to date, it would seem that the water fronts of the various Massachusetts ports offer unusually good rat harborage with abundant food. It is estimated that a good index of the presence or absence of infection among the rodent population could be determined after the examination of about 150,000 rats. Rat surveys carried on as suggested above would yield approximately this number.

It is recommended that each health department of the various seaports should be advised to carry on in perpetuity a continuous but moderate rat catch. This should yield a catch of about 50,000 rats a year, which would in all probability reveal the presence of infection at an early date after its introduction.

In addition to a continuous rat catch, each of the seaports should adopt proper ordinances for the fending off of all vessels and the proper placement of rat guards, an ordinance for the proper disposal of garbage, and an ordinance for the ratproofing of new and reconstructed buildings. Model ordinances along these lines are appended. Each town should adopt such ordinances in toto or in part, in so far as may be necessary to make the total legislation for each port contain at least the minimum requirements of these three ordinances.

AN ORDINANCE COMPELLING THE PLACING OF RAT GUARDS.

SECTION 1. *Be it ordained by* ——— *and the city of* ———, That from and after the promulgation of this ordinance it shall be unlawful for any vessel, steamboat, or other water craft, except harbor boats, to lie alongside of any wharf or dock in the city of ———, and such vessels, steamboats, or other water craft shall be fended off from said wharf or dock in such manner that no part of such vessel, steamboat, or other water craft shall be nearer than four feet from the nearest point of said wharf or dock by a floating fender or spars of sufficient strength to maintain said distance of four feet, and each such spar, and each such chain, hawser, rope, or line of any kind, extending from any such vessel, steamboat, or water craft, to said dock or wharf, shall be equipped with and have properly and securely attached thereto a rat shield or guard of such design, and in such manner, as shall be approved by ——— of the city of ———, except such harbor boats.

SEC. 2. *Be it further ordained, etc.*, That no gangplank, staging, ladder, skids, or other device whatsoever whereby rats and rodents may find egress from a vessel to such wharf, dock, or landing shall be ever allowed to extend from any vessel in communication with such wharf, landing, or dock except only during such times as such vessel is actually engaged in discharging or receiving cargo and at the time of loading or discharging cargo only when the master, owner, or agent of said vessel shall have stationed at every gangplank, and within five feet of the same, a person whose duty it shall be to prevent rats and rodents from reaching such wharf, dock, or landing from said vessel. When not actually in use all such staging, gangplanks, and other devices and means of egress for rats and rodents from vessels to shore shall be so removed as to positively cut off communication from such vessels to the dock, landing, or wharf.

SEC. 3. *Be it further ordained, etc.*, That after the hour of sunset all such gang planks, staging, or other structure, provided for in section 2 of this ordinance shall be removed from such wharf or dock: *Provided*, That when loading or unloading is required to be done after sunset, the same shall be done in the manner provided by section 2 of this ordinance: *And provided further*, That such light or lights shall be furnished by the owner, master, or other officer in charge of such vessel, steamboat, or other water craft, and so placed at or sufficiently near to each such gang plank, staging, or other structure as to so light such gang plank, staging, or other structure that the presence of rats may be easily and readily seen, and such additional competent men as may be necessary shall be detailed in the manner and for the purpose provided for in section 2 of this article: *Provided*, That the end of each such gang plank, staging, or other structure shall be kept whitened at all times when in use for a length of ten feet.

SEC. 4. *Be it further ordained, etc.*, That no crated cargo or empty barrels, boxes, or other containers, especially those from or intended for the store room shall be permitted to leave or be received aboard of any such vessel, steamboat, or other water craft until the same shall have been so inspected as to insure that they contain no rats.

SEC. 5. *Be it further ordained, etc.*, That the following definitions of words used in this ordinance are hereby adopted: "Vessel" is meant any boat engaged in traffic or the carrying of freight; "Wharf, dock, and landing" are meant and shall embrace any place where a vessel may land, discharge, or take on cargo or freight, receive or disembark passengers, whether the same be the natural shore or a structure or device of any kind that may be used for such purpose.

SEC. 6. *Be it further ordained, etc.*, That the owner, master, or agent of any vessel, or their servants or employees, or any person whomsoever, who shall violate any provision of this ordinance, shall upon conviction be punished by a fine not exceeding one hundred ($100.00) dollars or by imprisonment not exceeding thirty (30) days, or by both such fine and imprisonment, in the discretion of the ———.

SEC. 7. *Be it further ordained, etc.*, That each day's violation of any provision of this ordinance shall constitute a separate and distinct offense.

AN ORDINANCE REGULATING THE REMOVAL OF GARBAGE.

SECTION 1. *Be it ordained by ——— of the city of ———*, That from and after the promulgation of this ordinance, the owner, agent, and occupant of every premise, improved or unimproved, in the city of ———, whereon or wherein garbage shall be created, shall provide a metal, water-tight container or containers, each with a tight-fitting cover, such container or containers to be of such size as to be easily manhandled, and of such number as to receive the garbage accumulation of five days from each such premise, and shall place or cause to be placed such container or containers, for the purpose of having their contents removed, on the sidewalks or open alleys in front or rear of said premises, at the times hereinafter set forth.

SEC. 2. *Be it further ordained, etc.*, That for the purposes of this ordinance, the city of ——— is hereby divided into ——— garbage districts.

SEC. 3. *Be it further ordained, etc.*, That for the purpose of this ordinance, the word "garbage" as used in this ordinance shall be construed to mean house and kitchen offal, and all refuse matter not excrementitious liquid, and composed of animal or vegetable substances, including dead animals (except cows, horses, mules, and goats) coming from public and private premises of the city, and not destined for consumption as food.

SEC. 4. *Be it further ordained, etc.*, That it shall be unlawful for such owner, agent, or occupant of any such premise to have, maintain, or keep any garbage on any premise except in such garbage containers as are provided for in section 1 of this ordinance.

SEC. 5. *Be it further ordained, etc.*, That such garbage containers shall be kept tightly covered at all times, except when momentarily open to receive the garbage or to have the contents therefrom removed, as provided for hereinafter.

SEC. 6. *Be it further ordained, etc.*, That when such garbage container is placed on the outside of any premise it shall be unlawful for any person engaged in the removal of garbage, or for any person to remove the cover from such garbage container, except for the purpose of emptying its contents into a duly authorized garbage wagon or to throw such garbage container on the street or sidewalk, or to injure it in any way, so as to make it leak or to bend it or its cover, as to prevent said garbage container from being tightly covered; and all persons engaged in the removal of garbage shall, after emptying said container, replace the cover tightly on said container.

SEC. 7. *Be it further ordained, etc.*, That the owner, agent, or occupant of every premise in the city of ——— shall keep separate from their garbage and ashes, tin cans, broken crockery, hardware, old planks, wooden matter, paper, sweepings and other trash, and place same in a sound, substantial vessel or container kept for that purpose, which vessel or container shall be placed on the sidewalk or alley in front or rear of each premise of the city of ———, as provided in section 1 of this ordinance, for garbage containers, for removal on ———, provided that such rubbish, other than garbage, may be so placed ——— on ———.

SEC. 8. *Be it further ordained, etc.*, That the provisions of this ordinance shall apply to all public and private markets, as well as all places of business, hotels, restaurants, and all other premises, whether used for business, boarding, or residential purposes.

SEC. 9. *Be it further ordained, etc.*, That for the purpose of enforcing this ordinance any person living on any premise shall be deemed an occupant, and any person receiving the rent, in whole or in part, of any premise, shall be deemed an agent; that on any premise where construction of any kind is in progress, and where employees or workmen eat their dinners, or lunches, in or about said premises, or scatter lunch or food in or about such premises, the contractor or foreman or other person in charge of such workmen shall be deemed an occupant; and that the person in charge of any market, or stall in any market, shall be deemed an occupant.

SEC. 10. *Be it further ordained, etc.*, That it shall be unlawful for any person to pick from or disturb the contents of any garbage containers or vessels, or other containers provided for in this ordinance.

SEC. 11. *Be it further ordained, etc.*, That each day's violation of any of the provisions of this ordinance shall constitute a separate and distinct offense.

SEC. 12. *Be it further ordained, etc.*, That any person violating any provision of this ordinance shall, on conviction, be punished by a fine of not less than ten ($10.00) dollars nor more than twenty-five ($25.00) dollars, or in default of the payment of said fine by imprisonment——for not less than ten (10) days nor more than thirty (30) days, or both, at the discretion of—— having jurisdiction of the same.

SEC. 13. *Be it further ordained, etc.*, That any law or ordinance in conflict with the provisions of this ordinance, in whole or in part, be and the same is hereby repealed.

AN ORDINANCE DEFINING RAT PROOFING OF ALL BUILDINGS.

SECTION 1. *Be it ordained, etc.*, That it shall be unlawful for any person, firm, or corporation hereafter to construct any building, outhouse, or other superstructure, stable, lot, open area, or other premise, sidewalk, street, or alley, or to repair or remodel the same to an extent of —— per cent of cost of construction within the city of ——, unless the same shall be rat proofed in the manner hereinafter provided for.

SEC. 2. *Be it further ordained, etc.*, That for the purpose of rat proofing all buildings, outhouses, and other superstructures in the city of ——, except stables, shall be divided into two classes, to wit, class A and class B, and the same shall be rat proofed in the manner following, to wit:

Class A.—All buildings, outhouses, and other superstructures of class A shall have floors made of rat-proof material or of concrete, which concrete shall be not less than 3 inches thick, and overlaid with a top dressing of cement, mosaic, tiling, or other impermeable material laid in cement mortar, and such floor shall rest without any intervening space between upon the ground or upon filling of clean earth, sand, cinders, broken stone or brick, gravel, or similar material, which filling shall be free from animal or vegetable substances; said floor shall extend and be hermetically sealed to walls surrounding said floor, which walls shall be made of rat-proof material or of concrete, stone, or brick, laid in cement or mortar, and each wall shall be not less than 6 inches thick and shall extend into and below the surface of the surrounding ground at least 2 feet and shall extend not less than 1 foot above the surface of said floor; provided that wooden removable gratings may be laid on such concrete floors in such parts of such buildings, superstructures, and outhouses as are used exclusively as sales departments, provided that wooden flooring may be laid over the concrete wherever the intervening space between such flooring and the concrete shall not exceed one-half inch; provided further that any sleepers that are sunk into the concrete shall be creosoted.

Class B.—All accidental and unnecessary spaces and holes, ventilators, and other openings other than doors and windows in every building, outhouse or other superstructure in the city of ——, shall be closed with cement, mortar, or other material impervious to rats or screened with wire having not more than one-half inch mesh, as the case may require, and all wall spaces shall be closed with cement, mortar, or other material impervious to rats, which closure shall extend the full thickness of the wall and shall extend upward at least twelve inches above the floor level, and the whole in such manner as to prevent the ingress or egress of rats; or the ingress or egress of rats from such double wall or space may be prevented by protecting the junction of said wall with the floor or other wall with metal flashing of galvanized iron of 28 or 30 gauge, provided that where such double wall is open beneath or is in communication with foundations of the house that said opening shall be effectively closed or said junction with foundations flashed with metal as provided above: *Provided*, That in all buildings, outhouses, and other superstructures of class A and in all stables where there are any spaces in walls between the wall proper and the covering on same, or in ceilings between the ceiling and floor, or other ceiling covering above, said spaces shall be eliminated by the removal of said covering, or so closed with cement, mortar or other material impervious to rats as to prevent the ingress or egress of rats: *Provided*, That all such wall spaces shall be closed with cement, mortar, or other material impervious to rats, which closure shall extend the full thickness of the wall and shall extend upward at least twelve inches above the floor level.

The cellar of every building hereafter erected within the building limits shall be made rat proof by the use of masonry or metal. All openings in foundations, cellars and basements in such buildings, except for doors and hatchways, and except also for such windows wholly above ground as may be exempted by the ——— in his discretion, shall be completely covered with screens of metal having meshes of not more than one-half of an inch in least dimension and constructed of rods or wire of not less than twelve gauge.

All buildings, outhouses and other superstructures of class B separated from any other building on three sides by at least ten feet and lacking any basement or cellar may be rat-proofed in the following manner, to wit: Said building, outhouse, or other superstructure shall be set upon pillars or underpining of concrete, stone, or brick laid in cement mortar, or may be set upon underpinning of substantial timber, such pillars or underpinning to be not less than eighteen inches high, the height to be measured from the ground level to the top of said pillars or underpinning; and the intervening space between said building and the ground level to be open on three sides and to be free from all rubbish and other rat-harboring material, or may be made rat-proof by constructing at the margin of the ground area of said building a wall of concrete or brick or stone laid in cement; such wall to extend into and below the surface of the ground at least two feet and to meet the floor of the building above closely and without any intervening space, to be at least four inches thick and extend entirely around said building: *Provided*, That said walls may be built with openings therein for ventilation only: *And provided further*, That such openings for ventilation may be all of such size as the owner may elect and shall be securely screened with metallic gratings having openings between the bars of said gratings of not more than one-half inch or with wire mesh of not less than twelve gauge, having openings between the wires of said mesh of not more than one-half inch and the whole so constructed and closed as to prevent the entrance of rats beneath such building.

SEC. 3. *Be it further ordained, etc.*, That every restaurant kitchen, hotel kitchen, cabaret kitchen, dairy, dairy depot, dock, wharf, pier, elevator, store, manufactory, and every other building, outhouse, or superstructure wherein or whereon foodstuffs are stored, kept, handled, sold, held, or offered for sale, manufactured, prepared for market or for sale, except stables, shall be rat proofed in the manner provided for hereinabove as class A: *Provided*, That such part of any structure hereinabove defined as of class A that shall be entirely over a body of water may be rat proofed as of class B, as hereinafter provided for.

"Foodstuffs," as used in this ordinance, is hereby defined to be flour and flour products, animals and animal products, produce, groceries, cereals, grain, and the products of cereals and grain, poultry and its products, game, birds, fish, vegetables, fruit, milk, cream, and products from milk or cream, ice cream, hides, and tallow, or any combination of any one or more of the foregoing.

All other buildings, outhouses, and superstructures, except stables, not hereinbefore specified as class A, and all buildings used exclusively for residential purposes, shall be rat proofed in the manner provided for hereinabove as class B: *Provided*, That the owner of any building, residence, outhouse, or other superstructure in class B may, if he so elects, rat proof same in the manner provided for in class A.

Provided, That in any case where, under the foregoing provisions, any building, outhouse, or superstructure is required to be rat proofed as of class A and the said building or outhouse or superstructure is used in part for residential purposes, and the part used as a residence is effectively separated from the part falling within class A, by permanently and effectively closing all openings above and below the ground floor, or by constructing a new wall, and in either case the whole in such manner as to make such wall whole and continuous in its entirety, without doorways, windows, or other openings between the part used as a residence and that used for such purpose as makes it fall within class A, then in such case and for rat-proofing purposes only, the said building will, after such separation and closure of the openings, or by the construction of such new wall, be deemed to be two buildings; and that part used exclusively for residential purposes may be rat proofed in the manner provided for as a class B building, and the remaining part of said building shall be rat proofed in the manner provided for a class A building.

Stables.—Stables and all buildings hereafter to be constructed and used for stabling horses, mules, cows, and other animals shall be constructed as follows:

Walls: The walls of such buildings shall be constructed of concrete, brick, or stone, laid in cement mortar, and shall be not less than four inches thick, and shall extend into and below the surface of the surrounding ground not less than two feet, and shall extend above the ground sufficient height as to be not less than one foot above the floor level. All openings in such foundation walls shall be covered with metal grating having openings not greater than one-half inch between the gratings.

Floors: The floors of stables and stalls shall be of concrete not less than three inches thick, upon which shall be laid a dressing not less than one-half inch thick of cement or stone, laid in cement mortar, or shall be constructed of floated concrete not less than four inches thick, in such way as to prevent ingress or egress of rats, and such floors to have a slope of one-eighth inch per foot to the gutter drain hereinafter provided for.

Stalls: The floors of stalls may be of planking, fitting either tightly to the concrete floor or elevated not more than one-half inch from the stall floor, and so constructed as to be easily removable. Such removable planking shall be raised at least once a week, and the said planking and the concrete floor beneath thoroughly cleansed.

Gutters: Semicircular or V-shaped gutters shall be constructed in such manner that a gutter shall be placed so as to receive all liquid matter from each stall, and each of these gutters to connect with the public sewer or with a main gutter of the same construction, which in turn shall be connected with the public sewer or public drain. All openings from drains into sewers shall be protected by a metal grating having openings not more than one-half inch between the gratings.

Mangers: Each manger shall be constructed so as to have a slope of two inches towards the bottom, shall be covered with tin or zinc, and shall be at least eighteen inches deep, to avoid spilling of food.

Feed bins: All feed bins shall be constructed of cement, stone, metal, or wood, and with close-fitting doors. If constructed of wood, the bins shall be lined or covered with metal, and the whole so constructed as to prevent the ingress or egress of rats. All grain, malt, and other animal food, except hay, stored or kept in any stable, must be kept in such feed bins. Said feed bins must be kept closed at all times, except when momentarily opened, to take food therefrom, or when same are being filled. No feed shall be scattered about such bin or stable, and all such feed found on the floor or in the stalls of said stables shall be removed daily and placed in the manure pits. No foodstuffs intended for or susceptible of human consumption shall be kept or stored in any stable or any other place where animals are kept.

Sec. 4. *Be it further ordained, etc.*, That the construction and materials used in rat proofing shall conform to the building ordinances of the city of ———, except and only in so far as the same may be modified herein.

Sec. 5. *Be it further ordained, etc.*, That all premises, improved and unimproved, and all open lots, areas, streets, sidewalks, and alleys in the city of ——— shall be kept clean and free from all rubbish and similar loose material that might serve as a harborage for rats; and all lumber, boxes, barrels, loose iron, and similar material that may be permitted to remain thereon and that may be used as a harborage by rats shall be placed on supports and elevated not less than two feet from the ground, with a clear intervening space beneath, to prevent the harboring of rats.

Sec. 6. *Be it further ordained, etc.*, That all planking and plank walks on and in yards, alleys, alleyways, streets, sidewalks, or other open areas shall be removed and replaced with concrete, brick, or stone, laid in cement, gravel, or cinders, or the ground left bare.

Sec. 7. *Be it further ordained, etc.*, That it shall be the duty of every owner, agent, and occupant of each building, outhouse, and other superstructure, stable, lot, open area, and other premises, sidewalk, street, and alley in the city of ——— to comply with all the provisions of this ordinance.

Sec. 8. *Be it further ordained, etc.*, That it is hereby made the duty of ———, and particularly through its health department, to enforce the provisions of this ordinance.

Sec. 9. *Be it further ordained, etc.*, That any law or ordinance in conflict with the provisions of this ordinance be, and the same is hereby, repealed.

A PRELIMINARY REPORT ON THE RAT-PROOFING STATUS OF THE NEW YORK WATER FRONT WITH SUGGESTED METHODS OF IMPROVING CONDITIONS.

By E. C. Sullivan, Junior Assistant Sanitary Engineer, under the supervision of Sol Pincus, Associate Sanitary Engineer, United States Public Health Service.

PURPOSE.

The purpose of this report is to present the results of a preliminary investigation of the conditions with respect to rat proofing of the docks about metropolitan New York.

It is not intended to give a detailed account of the conditions found upon each dock, but to give a summary of the salient features encountered during visits to many docks in Manhattan, Brooklyn, and the Jersey shore of the Hudson River, to note defects, and to suggest methods of improvement.

INTRODUCTION.

Docks are of particular importance from a plague standpoint. The rodent population along a water front is usually very large. A plague infection usually obtains its foothold here, introduced by an infected rodent from some ship. It spreads through the rodent population and eventually human cases occur, usually first among dock workers. A rat-proof, rat-free water front is the first defense against an invasion of plague. In the past, rat proofing of docks has proved its value as a plague-control measure. Rat proofing is an enduring measure for reducing and controlling the propagation of the rodent population. For these reasons, it is of great importance that a water front should be as nearly rat proof as is possible.

Rat proofing of docks is an extremely expensive proposition. In this work, however, commercial and sanitary reasons go hand in hand. There is great economic gain from a rat-proof construction. The money saved through protection from the depredation of rats and in decreased labor costs due to increased efficiency with improved trucking and freight-handling facilities is a sufficient incentive for the reconstruction and replacement of many of the older structures.

To do all this rat proofing at once would severely tax available resources. Eventually it should be done. In the meantime, with comparatively little expense, there are many temporary and partially complete rat-proofing measures of great value. A large proportion of this sort of work can rightfully be called repair and maintenance work because much of rat proofing is nothing more than keeping property in repair. Broken walls and floors, rubbish, piles of waste material, and improper minor construction are conditions which ordinarily should be repaired and remedied. In this classification a great deal of rat proofing lies.

GENERAL INFORMATION.

The water front of metropolitan New York includes many miles of docks. The magnitude of the problem is so great that it is hard to comprehend. It includes docks on Staten Island, Jersey City, Hoboken, Weehawken, and Edgewater on the New Jersey shore of the Hudson River. It includes docks of Brooklyn and Long Island City. The water front of Manhattan proper, extending along the Hudson River and the East River, has close to 300 docks. In addition are the wharves along the Harlem River between Manhattan and the Bronx. A conservative estimate of the number of docks in metropolitan New York would be 2,000.

The ownership of the docks varies greatly. In Manhattan proper a large proportion of the wharves are owned by the city of New York and are under the supervision of the Department of Docks and Ferries. In Jersey City private interests own almost all of them. In Brooklyn dock companies control large stretches of the water front.

The docks of New York, as is to be expected, are used for every conceivable purpose and industry. There is no marked grouping of the use of docks by similar interests and industries in one section. There is a very rough grouping, however. The lower portion of the Hudson River side of Manhattan is used mainly by the railroads in the transportation of freight and passengers. Coastwise passengers and freight steamers are likewise located here. Farther up the river in the vicinity of pier 50 are located many of the trans-Atlantic passenger lines. Around pier 90 are grouped coal and construction material docks. Here and there along this side of Manhattan are located foreign and coastwise freight lines. The East River side of Manhattan is used principally by freight steamship interests; along the upper end are coal and material docks. Brooklyn is occupied mainly by freight transportation companies, and likewise Staten Island. The Jersey water front contains many railroad docks. Freight steamship lines predominate here. Farther up the river at Hoboken are grouped some trans-Atlantic passenger lines. The Harlem River water front contains many lumber docks.

GENERAL CONDITIONS.

As far as general rat proofing conditions are concerned, the Borough of Manhattan ranks best. A tight bulkhead, the rear of which is completely filled in, is an important factor in the elimination of rodent harborages. Large portions of the Manhattan water front are provided with bulkheads of stone or concrete, completely filled in behind and paved. There are stretches, however, where such bulkheads do not exist and the conditions there are such as to ably illustrate the need of properly protecting land areas along a commercial water front from rodents. (Piers 89, 90, North River.)

In Brooklyn, at the Atlantic Basin, the evidence of rat harborage is marked. A wooden bulkhead exists here. The rear is partially filled with earth and partially built up on cribwork to form a dock paved with wood plank. Rat holes through this planking are common.

In Jersey City, a wooden bulkhead extends along the water front. It is rotted out and broken in places. A tight wooden bulkhead, if kept in proper repair, is satisfactory. More often, however, it is not maintained in proper condition but is allowed to decay and rot, and to become honeycombed with rat holes leading to hiding places which have been made behind the bulkhead.

In Manhattan, many of the docks are new, well lighted and airy. Very few were encountered of such age that their existence is a menace. Many need minor repairs and changes.

In Brooklyn, of the docks inspected, none were obsolete, although the majority of them were not of the most recent construction.

In Jersey City, none of the docks inspected were of recent design. Usually, they were very dark and dingy. Wooden floors are the usual type of flooring.

TYPE OF DOCKS.

The usual type of dock found in New York extends out into the stream. Ships ordinarily are tied up at right angles to the channel. It is very seldom that a dock is so constructed that the ships tie up along the shore parallel to the channel. In Brooklyn, there are several examples (Atlantic Basin, Erie Basin) of the basin type of dock. In this design, advantage is taken of an indentation in the shore line to construct the docks so as to utilize the indentation as a bay protected by the two outer docks or by a sea wall.

The usual type of docks encountered are: (1) Open docks, (2) garbage docks, (3) ferry slips, and (4) inclosed docks.

By open docks are designated docks or piers without a shed. They simply consist of the substructure supporting the dock floor. The latter is usually of wood, sometimes of concrete or paved with wood blocks. If we neglect to consider the substructure, this type of dock is unimportant from a plague standpoint provided it has a tight floor and is kept clean and free from rat-harboring material. This type of dock is used chiefly by canal barges, coal boats, and similar craft.

Regarding garbage docks, there is need of great improvement. This is the type of dock used for the loading of garbage barges. It usually consists of a former open dock upon which has been constructed an inclined driveway and elevated platform for the unloading of the carts to the scows by gravity. The lower deck of the dock usually has a layer of garbage and rubbish 4 to 18 inches thick. Ordinarily they are located at points along the water front where there is no bulkhead with consequent abundant rat harborage. Garbage docks are one place in particular where Manhattan Borough should take measures to improve conditions.

The large number of ferry slips found about New York make them a special problem in themselves. While there is little danger from the possibilities of the introduction of plague infection at such points, the abundant food supply due to passenger refuse and the harboring places found there renders them a particular problem for attention. To eliminate the food supply available for rats by more thorough scavenger service is one step in the process of providing more satisfactory conditions.

The most common type of dock found about New York is that in which practically all of the floor surface is inclosed with a shed. Commonly, it is of one-story construction. This type of construction comprises the main field for rat-proofing operations about New York. As it is worthy of much consideration, it is the intent of this report to further consider this type of construction in the paragraphs on substructure and superstructure.

SUBSTRUCTURE.

The usual type of substructure is rows of piles, the rows being about 15 feet center to center extending out into the stream. Very seldom is any longitudinal cross bracing evident. This absence appears to be an admirable feature. It tends to prevent rat harborage underneath the dock, due to lack of "rat runs." If the dock has a tight floor, the rat has neither ingress to nor engress from the dark spaces below on the underpinning. If he should happen to get there, he is isolated without the presence of the longitudinal bracing for his highways or "rat runs."

In the construction of most of the docks, it seems customary to have along the edge of the docks, a few feet below the floor proper, a heavy timber, partly for bracing and partly for fending purposes. The presence of this timber fender tends to enable rats to travel along the substructure to shore. To eliminate this timber or to alter its construction so as to block the rat's travel in the last few panels toward shore seems desirable.

It is the practice in docks used in connection with railroad barges to sheath up the sides of the substructure in order to enable the barges to be more easily handled. Absence of light is a factor contributing to rat harborage, and to sheath up the sides of the dock in this manner makes an ideal breeding place for rats if other conditions are suitable. Spacing of this sheathing to admit a maximum of light would materially assist in improving conditions. Examples of this condition may be found at almost any one of the railroad freight piers.

Pier 1, North River, possesses a type of substructure quite different from any other encountered. It consists of stone arches and appears to be as nearly a rat-proof substructure as can be built. Pier 86, North River, is constructed with concrete walls running out into the stream for about 100 feet from shore. With a concrete bulkhead and an asphalt floor above, any rodents below will have a rather difficult task to find egress at the shore end of the pier.

SUPERSTRUCTURE.

The latest docks have a light framework covered with heavy galvanized iron. This type of construction affords very little, if any, rat-harboring places. A few instances were noted where the arrangement and type of steel members were such that rat runs were formed along the eaves and bracing of the sheds. (Pier 45, North River.) Care and ingenuity in the design can eliminate this.

The newer docks are light and airy. Some of the older types are very dark and have much timber in their construction. (Pier 1, North River.)

In many of the docks, the sheet iron sides are protected with wood plank sheathing. Often, the planks are so close together that they practically form a double wall to the building. (Piers 10, 11, 17, North River, 7, East River.) There should be no such sheathing for a distance up of at least 12 inches from the floor. Above that point the planks should be spaced as far apart as practicable (from 6 to 12 inches).

Asphalt flooring is undoubtedly the most desirable type of flooring. Many of the newer docks are so paved. All of the older docks have wood floors in a variable condition of repair. Next to an asphalt or concrete pavement, a tight wood floor is the most feasible material for a rat-proof floor to a dock. But the task of keeping it in proper shape is difficult. Expanded metal laid between two layers of plank has been used successfully in some instances in other places for the rat proofing of floors.

A floor, irrespective of the material, must be protected along the edge. Otherwise, to endeavor to rat proof is useless. A foundation wall around the edges extending a sufficient depth into the ground to prevent rats burrowing beneath should be included in the construction. In the South, a wall 2 feet in depth has been found to be satisfactory for this purpose. There are numerous examples along the New York water front of neglect of this point. One of the worst examples in this respect is Pier 84, North River.

Gratings, drains, and pipe culverts passing through floors or walls need special consideration to prevent the admission of rats. Gratings were seen with 1¼-inch holes through which rodents easily can make their way. (Pier 44, East River.) In plague control work any opening larger than one-half inch is open to suspicion. Drain and pipe culverts should have no openings around the edges. There should be a close fit to anything through which they pass. Flashing with light galvanized iron is one way of accomplishing this result.

On many docks, particularly railroad freight docks, it is customary to have raised loading platforms inclosed with plank. Usually the wooden box so formed is not tight and provides an excellent rat harbor. (Piers 12, 34, East River.) The problem of dealing with these platforms so that no rat harborages are provided is a most difficult one. If the space between the main dock flooring and the elevated platform is left unsheathed, or is wired with screen wire, principally to prevent the placing of rubbish therein, it seems possible that the rats will be discouraged from making their homes there, on account of the light and openness of the space. Otherwise, these raised platforms will be a distinct rat menace, for it is highly improbable that the two floors, the sheathing and the entire space underneath the loading platform, can be constructed and maintained rat proof.

In designing docks it seems customary to have the front of the structure resplendent with double-walled galvanized iron columns and walls. In a short time these double walls are broken by trucks, and entrance being gained, make an ideal refuge for rodents. The rusting out in the course of time is another mode of admission for rats. To eliminate this double-walled construction as much as possible and to protect it by concrete footings and fenders would be of material assistance. (Piers 4, 5, 27, 31, East River; 95, 96, 97, North River.)

It is customary to have small double-walled office buildings upon the docks. Sometimes they are built satisfactorily with no openings either in their own walls or between their own walls and the walls of the shed and rest flush with the dock floor. More often they are defective, either due to broken walls or floors or unnecessary openings and dark holes. To improve this state of affairs is a minor matter which should be given due consideration. (Piers 4, 5, 27, 31, East River.)

There are many minor defects about otherwise practically rat-proof docks which tend to neutralize the effect of very good rat proofing. At Piers 51–61, North River, a raised platform and unnecessary spaces in the rear of dock houses are examples of this. Closets beneath staircase and inclosed staircases are other things in the same class. (Pier 13, North River.)

SPECIAL CONSIDERATIONS.

In course of these investigations many docks were visited where there were piles of rubbish and old timber. These had evidently existed undisturbed for some time. In order to obtain maximum return for rat proofing secondary factors such as these need attention. Piles of stuff, undisturbed for months, are likely to harbor rats, and to unnecessarily increase this evil through neglect is very unwise. It is evident, even from the most casual inspection of many docks, that to institute and maintain a thorough "clean-up" campaign would produce many beneficial results.

The present practice of constructing wooden plank walks and platforms elevated a few inches above the pavement on the docks and along the water front should be abandoned. Existing platforms of this type should be removed. A particularly impressive example of this evil is to be found at the floating oyster market beneath Manhattan Bridge. Here, between Piers 31 and 32, there exists a wooden platform, elevated about 1 foot above the paved roadway and about 15 feet wide. It can not be anything else but a veritable rat den, particularly with the food and refuse that is scattered about. Between Piers 28 and 29, East River, there exists a somewhat similar arrangement. In cases where it is impossible to dispense with such platforms they should be laid directly upon the ground surface, with no intervening space.

SUMMARY.

I. In the replacement of the older docks rat-proof construction should be considered a factor of great importance. Minor defects, which will tend to neutralize the effect of the major expenditure of money, should be carefully avoided.

II. Perhaps 15 per cent of the docks about New York, the majority of which are in the Borough of Manhattan, may be called "rat proof."

III. In view of the ideal conditions about the garbage docks for rodent breeding and harborage, it is of great importance that the earliest steps in a rodent-eradication or rat-proofing campaign should include measures to improve conditions about these structures.

IV. Unnecessary wood planked areas should be removed. Slightly elevated wood platforms are dangerous from a plague standpoint.

V. Minor improvements about docks such as repairs to broken double walls and floors, elimination of unnecessary dark spaces beneath and behind small structures on the docks, changes of sheathing so as not to form double walled spaces, removal of rubbish, etc., should be one of the first measures instituted in a rat-combative campaign.

VI. It should be strongly brought to the attention of those concerned with the docks how unsatisfactory it is to install upon docks wooden platforms and similar structures of such design and location that they tend to make ideal breeding places for rodents. Simplicity of design is a factor which tends to make a rat-proof structure.

A REPORT OF AN INVESTIGATION OF THE RODENT INFESTATION AND RAT-PROOFING CONDITION OF THE CITY OF BALTIMORE, MD., TOGETHER WITH RECOMMENDATIONS.

By A. F. ALLEN, Associate Sanitary Engineer, United States Public Health Service.

Under date of April 15 the writer was ordered by the Surgeon General of the Public Health Service to report to Dr. C. Hampson Jones, city health commissioner of the city of Baltimore, Md., on or about May 1, for the purpose of assisting Dr. Jones in such way as might be possible in determining the extent of the rodent infestation of the city of Baltimore and in giving such advice as might be advisable as to the means of overcoming or controlling this infestation, particularly with a view to ascertaining the practicable means of determining whether or not rodent plague may have secured a foothold in Baltimore; and, further, a study of conditions and means of correcting them to insure as far as possible the relative rat proofing of the buildings in the city to the extent that should rodent or human plague at any time make its appearance in the city a means might be at hand for readily combating the initial appearance of such plague.

The writer has spent several weeks in Baltimore in studying the problems outlined and in determining what seems to be a practicable solution thereof.

It was very quickly seen that the solution of the problems confronting the city lay not only in the city health department, but also those of street cleaning and of building inspection—the former because of the fact that at present certain rodent destructive activities are carried out by that department, the second because of the fact that it is only proper and fitting that all rat-proof building inspection falls within the jurisdiction of that official.

The need of a study of this kind in the city of Baltimore should be very apparent, but a few words in regard to the world-wide prevalence of plague will further emphasize this point. It can be very briefly stated that within the past few years rodent or human plague has made its appearance in many seaports, large and small, distributed over the entire world.

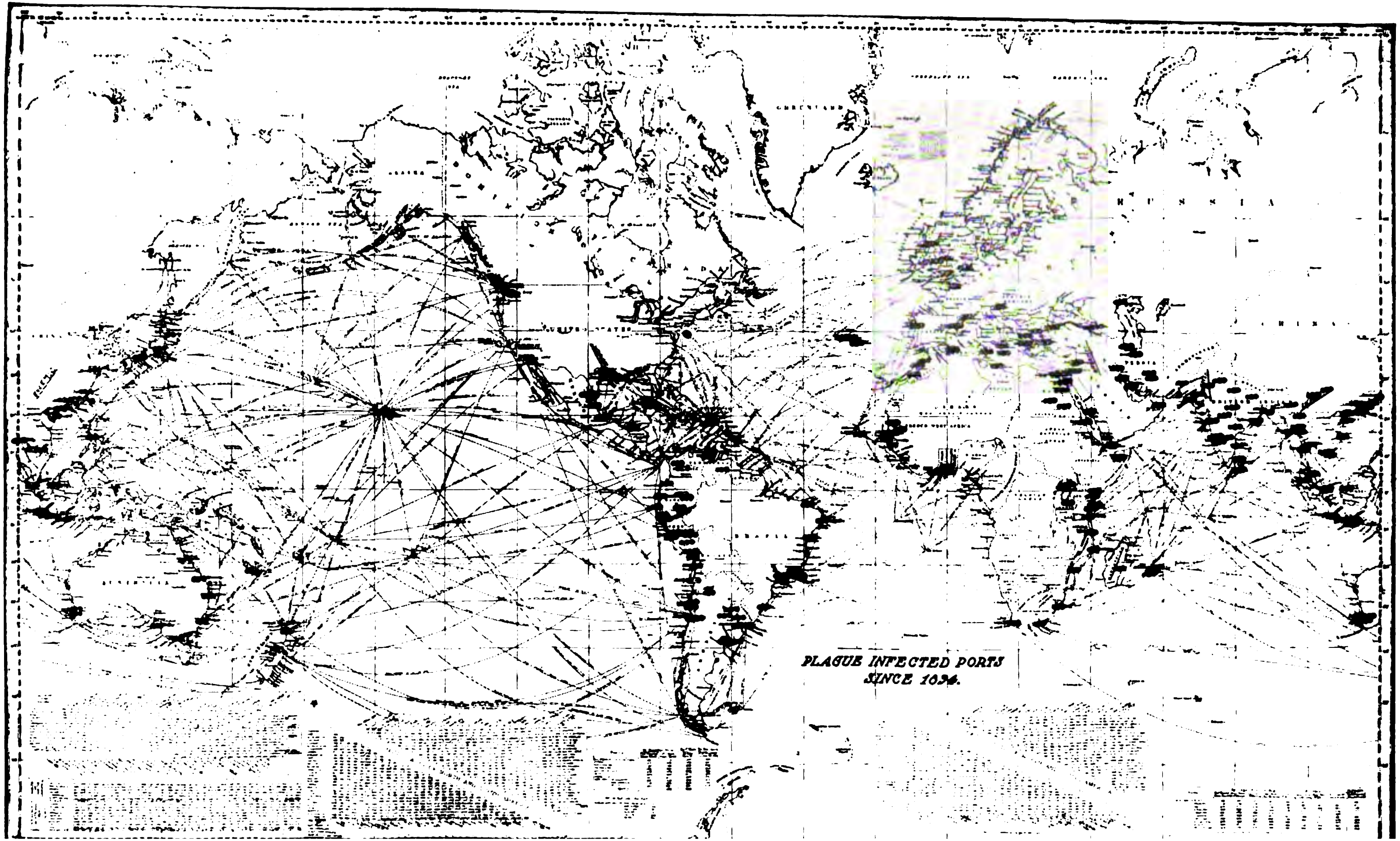
By a strange and unexplained condition, the eastern seacoast of the United States, from Florida to Maine, has up until the present reported no human or rodent plague. With the exception of the northern and northwestern seacoast of Norway, this is the longest stretch of seacoast in the world that has not within the past few years reported plague along its shores. It would seem, therefore, that if chance alone controlled the question of the appearance of plague that this eastern seacoast of ours would be due to be visited very shortly by plague in some form or other. Accordingly, it is not only wise but very necessary that the cities along the seacoast should take heed unto themselves to do all within their means that it is possible to do to head off and prevent the impending danger to themselves.

Although the signatories to The Hague Peace Tribunal have agreed that all ships calling at their ports should be fumigated every six months for the destruction of rodents, unfortunately, the carrying out of this agreement effectively can not be relied upon at the present time as a means of controlling the rodent problem on board ships calling at the seaport towns of our eastern coast, and it is, therefore, necessary that each city of itself take the proper steps to prevent the introduction of plague into its own port.

Having thus briefly stated the world-wide point of view of the spread of plague, attention should be called to only a brief statement of the method of its transmission, namely, that plague is essentially a disease of rodents, being transmitted from one to another by the bite of a flea, which carries the germ from a sick rodent to a well one, or in the absence of any well rodents from a sick rodent to the nearest human host. It is evident, therefore, that checking of the transmission of plague depends upon either the control of the number of rodents within a community or the control of the number of fleas upon the rodents within the community. At present the latter is not a feasible means, and we are compelled, therefore, to direct our activities to the rats.

To briefly state a few facts in regard to rats, it may be said that they are classified into three groups: The ground rat, the house rat, and wild field rats, to which should be added a class of mice which are not properly considered as rats. The method of rat proofing of buildings or areas depends upon which kind of rats are found in or upon such building or area. If the ground rat is present rat proofing activities are directed primarily at the ground areas of the buildings; if the house rat is present greater emphasis is laid upon walls, floors above ceilings, and passageways within walls; if the undomesticated field rat is present the problem of rat proofing of buildings need receive little consideration as they seldom or ever enter into buildings.

The underlying principles of rat proofing consist of creating conditions which are unfavorable: First, to the presence of rats; second, to their securing food; and third, for the production of their young. In securing the former we rely largely upon the introduction of plenty of light to the place where rats ordinarily would be found,


CANADA
RUSSIA
PLAGUE INFECTED PORTS
SINCE 1094.

since rats will not remain in well-lighted areas. This principle has resulted in the rather extensive use in the southern climates of the method of elevation, so-called, of rat proofing, whereby the building is elevated upon piles to a height such that light reaches all areas underneath the building. Of course, this method is not applicable to dwellings in the colder northern climates, but the principle may be applied somewhat by the installation of windows admitting light to dark basements and ground floors.

In separating the rat from his food the main reliance is placed upon proper garbage removal, together with the maintenance of all large food supplies in all buildings in rodent-proof rooms—that is, rooms, the floors, walls, and ceilings of which are impermeable to rodents. This means either concrete floors and walls or wooden floors and walls covered with metal, the doors thereof properly protected by metal to prevent the gnawing of rats.

In establishing and maintaining conditions which tend to prevent rats from raising their young we rely largely in the case of ground rats upon the covering of the ground area of the building with a rodent-proof material carrying the walls of such building down into the ground to such a depth that rats may not burrow underneath these walls, there finding lodging and shelter. In the case of house rats, the problem of preventing as far as possible the raising of young depends upon the removing of spaces within walls and double ceilings where house rats make their nests.

In every city there are numerous instances of unnecessary wooden, concrete, and brick walks, and also unused shacks, all of which harbor rats, which can best be rat proofed by destruction, thereby not only securing good rat proofing but increasing the general sanitary tone of the community, and it has been found in plague-campaign operations that the destruction of these unnecessary low-lying, wooden, concrete, or brick floors has resulted in the greatest possible measure of rodent control.

In studying the situation in Baltimore, it has been possible only to touch the high spots of the problem, and, in brief, the method of study has been as follows:

First, a general survey of the water front, for it is along the coast line that our interest first of all must lie, since it is across the wharves that plague is usually introduced into a community. Next of all, a very general and hurried inspection, in company with inspectors of the building department, was made of groups of buildings in typical sections of the community: First, of a group of wharves; next of a wholesale produce-house district; next of a business district; and lastly of two types of residential districts, one being the isolated home, both wood and brick construction, and the other of the brick row tenement house so very common in Baltimore.

A considerable amount of time was spent in the study of Baltimore's building laws; first of the building code of 1908, which at present is in operation; and second, of the proposed building code now under consideration. These are discussed at length in this report.

With an inspector of the street-cleaning department's office, some time was spent in observing the activities of that department in rodent extermination and collection.

Based upon a knowledge of general facts outlined above, and the specific instances observed in Baltimore, this report has been written with an idea of making it not so much a statement of ideal conditions to be desired but rather of stating what, in the writer's opinion, is at the present time, at least, the most practical solution of Baltimore's rat problem.

EXTENT OF RODENT INFECTION.

In passing over the wharves, and through the buildings on them, there was observed much evidence of the presence of rats, both of the ground rat and of the house rat. It would appear that the ground rat has in many instances formed burrows under the buildings, on the wharves, and that the house rat must be living within the walls. In many instances extensive "rat swings" were observed, the latter being the places where the rat in passing along stringers leaves marks of his body on vertical joists and building walls. On those wharves, across which food materials pass, were found, as may have been expected, the greatest number of evidences of the presence of rats.

Generally throughout the city there was no difficulty in finding plenty of evidence of the presence of the ground rat. This is especially so in the residential district lying a mile or more from the water front, and in this connection it might be stated that in the few instances carefully observed the rat burrows, originating outside of basement walls, extended at least 4 feet below the ground surface.

In the rather limited investigations it was noted that no evidences of house rats were observed more than 10 blocks from the water front. It would take rather extensive observations to check the accuracy of this statement but it should be borne in mind as indicating that the immediate water front is probably the main source of infection of this type of rodent.

In general it may be stated that there is in Baltimore plenty of evidence of rodents and that it would appear that the infestation is of both types of rats, the house and the ground rat, and that apparently there are very few mice, at least in the business district. No observations were made in regard to the presence of the wild field rat.

Fortunately, we have a few specific instances of the extent of rodent infection within the city, these being in the Fort McHenry district, where under the Public Health Service trapping for rodents has been carred out for nearly a year, and second from rather limited figures as to the number of dead rats collected by the street cleaning department.

In the summer of 1920, an experienced rat trapper from New Orleans was detailed to Fort McHenry for the purpose of controlling the rodents which were at that time a nuisance within the reservation. He reports that several thousand rats were captured, the ground rat and the house rat being very nearly equally distributed in numbers, but since his traps were mainly on the ground he got the ground rats first, later taking the house rats, who, when the ground rats were removed, came down from the building to the ground.

After a conference with the city health commissioner, the commissioner of street cleaning made arrangements in his department whereby, beginning the first week in June, a record might be had of the number of dead rodents picked up by the street cleaning and garbage collection force from the alleys, trash cans, and as far as possible from the garbage cans. These have averaged about 2,000 rodents a week,[1] the specific figures being:

Week ending June 7	2, 196
Week ending June 14	1, 893
Week ending June 21	2, 211
Week ending June 28	2, 050

These were collected within the old Baltimore city limits covering an area of approximately 31 square miles. In addition to those, during the week of June 7 the dead animal collection force reported 219 dead rats collected by them. It would appear, therefore, that a rather considerable number of dead rodents are finding their way either into the incinerator or the dumps of the city. Certainly, these rodents should be examined for plague, since, if any rats are dying of plague within the city, they would be most probably found among those so collected.

It is evident from the general observations made, as well as the few specific instances at hand, that Baltimore's rodent infestation is probably as great as any other seaport city. Certainly there are large numbers of rats within the city which are capable of great economic damage as well as being a potential danger to the public health.

CONTROL IN GENERAL OF RODENT INFESTATION.

The details of the general methods of the capture, control, and destruction of rodents within a community are in general very well known and need not at this time be specifically elaborated upon, but it might be stated that they fall into four general classifications, namely, hunting, poisoning, the use of natural enemies, and rat proofing, the general features of which have been outlined in the foregoing pages.

---

[1] Period June 28, 1921, to January 1, 1922, 32,397 rodents.

Trapping, one of the hunting methods, is at present our main reliance for the capture of rodents. Probably the best trap for the purpose of capture and destruction is the ordinary snap trap baited with bread, meat, or fish. Cage traps, preferably the half barrel, 24-inch length size, likewise baited with bread or meat are necessary for the capture of live rats that the number of fleas per rat may be determined, since this factor is very important in the transmission of plague from rat to rat or from rat to man. Fleas will not remain on a dead rat. Barrel traps half filled with water provided with a tipping cover are very useful in inaugurating a campaign in an area heavily infested with rats. For ordinary usage one trapper provided with 100 or 150 snap traps and about a dozen cage traps will be kept busy in making one round of his traps each day, and under campaign conditions will average from one dozen to two dozen rats a day.

Indiscriminate use of poisoned food is a very dangerous method of rodent extermination in cities, due to the possibility of the destruction of other animals than rats, and of poisoning children. It, however, has its very useful place in eliminating rats from places where traps can not be placed, such as sewers, underground conduits, or places where traps would be floated off or lost in periods of high water. Gaseous poisoning is very effective, but is extremely dangerous, and can be used only by highly trained operators. Poisoning can only be considered as a means of controlling the economic damage done by rats, since poisoned rats are usually lost for laboratory examination to determine whether or not they may have been plague-infected.

Natural enemies such as cats, dogs, ferrets, and the like, are extremely unreliable and limited in their application toward rodent destruction.

Unfortunately, the general public expects altogether too much of rat proofing, and fails to realize that rodents may enter into even the most satisfactorily rat-proof building ever constructed. Rat proofing is, however of great value. It not only increases the general sanitary tone of the community by providing better construction, but also diminishes the fire hazard and corrects many insanitary defects which would otherwise not be noticed, and, of course, in addition to this it does, to a rather large extent, aid in the control of the rate of propagation of rodents. Furthermore, in the presence of rodent or human plague it brings such plague cases to the attention of the authorities earlier than they would otherwise appear. This last is due to the fact that the sick and dying plague rat is unable in a rat-proof community to hide away by himself, and the sick, dying, and dead rats in a rat-proof building are rather quickly observed by the occupants and reported to the authorities.

It can be recommended, therefore, in general in order to control rodent infestation:

1. That Baltimore should undertake the establishment of a trapping force for the purpose of capturing and destroying rodents within the city.
2. That for the present any general and indiscriminate use of poison should be avoided.
3. That, as subsequently elaborated upon, rat-proofing operations within the city be inaugurated.

These recommendations will attack the problem both from its economic side, which is primarily concerned in the destruction of rodents, and also from the health side of the problem, which is concerned with the capture of rodents for the purposes of laboratory examination.

DETERMINATION OF THE PRESENCE OF PLAGUE.

With our present knowledge of the transmission and control of rodent and human plague we have come to rely very largely on laboratory examination, by means of autopsies of all rodents, finding within their bodies the typical lesions caused by the plague bacillus. To effect as completely as possible this end it is necessary that all rats either found dead within the city or captured alive or dead in traps should be delivered to a municipally operated laboratory, preferably under the control of the health department, where they may be examined. It is needless to add that the place of capture or finding of each rat should be known. The following three specific recommendations may, therefore, be made with an idea of determining the presence of rodent plague within the city:

1. It may be recommended that the trapping force, above proposed, should be considered as a unit of about eight or ten trappers under the supervision of a competent foreman, provided with the proper equipment, operating under the general jurisdiction of the health department. If possible, the foreman should be a man experienced in his work, or in the absence of such experience a man should be given proper training along this line. This unit of 8 or 10 men under a foreman should be considered the nucleus of a more extensive trapping force should the plague ever make its appearance within the city. This force will probably supply enough rats per day to the laboratory to enable that recommended force to operate at its maximum efficiency. The principal function of this

trapping force should be to trap areas along the water front and the various dumps within the city, principally for the purposes of securing rats to determine the presence or absence of rodent plague infection. It should not be considered at this time, at least, as a rodent-control force for the general purpose of eliminating or reducing the rodent population within the city.

2. It may be recommended that the efforts of the health department and the street cleaning department be coordinated with the result that all rodents collected by both may be so tagged as to tell their point of origin and then delivered to the rodent-examining laboratory for the purpose of classification and examination. Any other agencies concerned, such as the dead animal collection wagon, should also have their activities coordinated along the same line.

3. It may be recommended that a laboratory properly equipped and suitably located be established under the jurisdiction of the health department, for the purpose of examining and classifying the rats that may be delivered to it. This examination should include macroscopic as well as microscopic examinations, animal inoculation, and cultural methods of identification of organisms recovered from the rodent. It will be advisable that a director in charge with a laboratory assistant and a clerk be provided. This is the minimum operating force. In addition, space for a sufficient number of laboratory animals and an incinerator should be provided.

With the inauguration and carrying into effect of these recommendations there will be provided means whereby any presence of rodent plague within the city of Baltimore may be determined, and this is always the first step necessary in the detection and control of a human epidemic.

STUDY OF THE CONDITIONS OF BUILDINGS WITH REFERENCE TO RAT PROOFING.

Each and every building in a city is a subject for individual study in regard to the details of rat proofing inasmuch as not two of them present the same problem.

In the limited time available no attempt could be made to make more than broad general deductions based upon a few specific observations.

The buildings in Baltimore can be given a rather unique classification; as those constructed prior to and subsequent to the destructive fire of 1904.

Generally speaking, those buildings now standing which were built prior to this fire are of a construction type apparently built with little supervisional control by governmental authority, and they present a most widespread and diverse set of building conditions. They will be very hard to handle in regard to correction of rat-proofing conditions at the present time, although in them the need is really the greatest. I believe, however, it is unwise at this time to formulate legislation in regard to them. In the presence of an epidemic of plague, however, they would fall within the provisions of the building code as subsequently noted, and could at that time be forced to make improvements to protect the health of the occupants. Furthermore, many of these buildings will probably within the next few years be destroyed. Many of the owners of these properties are either desirous to or would willingly cooperate with the municipal authorities in a movement tending to correct the rat menace which these buildings now present.

In the buildings constructed according to the 1908 code, the general provisions of rat proofing have been fairly well carried out, but it may be briefly stated that many details of construction so essential from a rat-proofing point of view have been oftentimes overlooked and neglected.

In almost every building which was visited it seemed that very simple and inexpensive means could be utilized to overcome the defects present. I believe that an energetic, conscientious, trained worker could by his own endeavors stimulate much in the way of corrective changes in both the older type of buildings and also in the more recently constructed ones.

There is only one type of building construction in Baltimore, which for the purpose of this report need be described in detail, and that is the method that is very commonly used in the construction of wharves within the city.

WHARF CONSTRUCTION.

Generally speaking, the Baltimore wharves are of the pier type, extending out from the shore and alongside of which the steamships dock. Almost universally they are supported upon piles which are cut off just below low-water line. Upon the top of these cut-off piles is constructed a decking of either timber or concrete. Around the edges of this decking is built a retaining wall, either of wood cribbing or of concrete, of the gravity type cross-section. This retaining wall usually extends about 2 or 3 feet above high water. Upon the decking and within the retaining walls is dumped an earth fill which is leveled off with the top of the retaining wall. Upon this earth fill is constructed the wharf superstructure, the floors and other features of which fall within the provisions of the building laws.

Viewed from a distance these wharves appear to be either concrete masonry construction or of timber cribbing since the piling supporting the retaining wall is invisible, being entirely submerged.

This type of construction is very satisfactory from a rat-proofing point of view, and since the possible defects in rat proofing are covered by the building laws, I believe that very little worry may be had in regard to future wharf construction of this type. However, the flooring and superstructure of all wharves should be thoroughly studied and every means taken to correct existing danger spots.

STUDY OF PRESENT BUILDING CODE.

In carrying out the rat-proofing operations in any city, it is always advisable that if possible the existing building laws be utilized as far as they are applicable and, if necessary, modified with an idea of creating rat-proof buildings within the city.

The present building code of the city of Baltimore is the 1908 revision of Article VII of the City Code of 1893. Certain paragraphs of this cover points that are important, governing the rat proofing of the city. The paragraph numbers referred to are the "whole number paragraphs."

Paragraph 119 states that all tests of new materials and of cements shall be made as directed by the inspector of buildings, and that all tests of cement shall conform to the standard of the American Society of Civil Engineers.

Paragraphs 123–125 permit new materials and methods of construction other than those specified and specifically covered in the code.

Paragraph 201 defines a footing as that part of the foundation wall below the beginning of the spread.

Paragraph 209–211 define terra cotta, hard terra cotta, semiporous terra cotta having 20 per cent sawdust, and porous terra cotta having 50 per cent sawdust. These last two should not be considered as permissible rat-proof materials.

Paragraphs 223–224 define limits including the greater part of the business portion of the city, within which no frame or other wooden structures are to be built.

Paragraph 268 defines frame buildings as any building with exterior walls of wood or wood sheathed with 4 inches of brickwork or wood frame covered with metal or lathed and plastered on the outside.

Paragraph 285 subjects all materials to the approval of the building inspector.

Paragraph 295 defines the standard of every brand of Portland cement.

Paragraph 296 defines sand as being clean, sharp, not more than 5 per cent clay or loam and free from vegetable or other deleterious foreign matter.

Paragraph 299 defines cement mortars as being 1 part Portland cement and not more than 3 parts sand.

Paragraph 303 defines foundation concrete as being 1:3:5 mixtures.

Paragraph 437 states that excavations for footings be not less than 3 feet below the surface, except for frame buildings. This is an important paragraph from a rat-proofing point of view, and the exception is an unwise one when considered as a rat-proofiing measure.

Paragraph 453 states that the tops of wood piles for foundations shall be cut off below mean low tide.

Paragraph 456 covers special regulations for piles in structures over water where piles extend above water.

Paragraph 469 is probably the most important paragraph in the regulations in regard to securing rat-proofiing. It states that the floor of cellar or lowest story of every dwelling, hotel, lodging house, apartment, office building, hospital or other institution for care or treatment of persons, and every building in which manufacturing is carried on shall be made of concrete not less than 3 inches thick with a top finish of cement mortar, 1 inch thick, said mortar being made of 1 part cement to not over 2 parts sand. This paragraph should include restaurants, food depots, and stables.

Paragraph 471 permits wood floors to be laid on concrete floors, but with the sleepers on top of the concrete. This is poor rat proofing, since it permits of the possibility of rats passing underneath the wood floors or making their nests between the wood and concrete floors. It is customary in rat-proofing ordinances to limit the space between concrete and wood floors to one-half inch, or to permit sleepers to be embedded in the concrete, thus insuring no space between the concrete and the wood floors.

Paragraph 472 permits this last requirement, but only in low-ground areas, which is a rather unusual limitation.

Paragraph 528 permits the space between the top of the slab and the floor to be filled with a cinder filling of 1 part cement, with not more than 8 parts cinders.

Paragraph 530 states that the wood sleepers and wood flooring shall not extend under any partition.

Paragraph 637 states that in reinforced concrete there shall be at least 2 inches of concrete covering reinforcing bars.

Paragraph 684 states that cement used in making blocks shall be made according to the standard specification of the American Society for Testing Materials.

Paragraph 1556 excepts grain elevators from the provision of the article.

Paragraph 1847 provides that footings for foundations of walls for frame buildings built on the ground shall be laid not less than 3 feet below lowest surface of the ground.

Paragraph 1848 provides that walls shall extend to bottom of the sill. This is an important measure and should be thoroughly enforced, since it covers the usual provisions of the rat-proofing ordinance defined to eliminate the so-called "open wall base."

Paragraph 1854 provides that the bottom of the wall shall not be less than 2 feet above ground, unless the story is used for business purposes.

Paragraph 1862 is an important paragraph from a rat-proofing point of view, which provides that the space between studding or wall timbers in exterior and interior walls of every frame building which is sheathed, plastered, or otherwise covered on both sides of the studding or other wall timbers shall be filled in with brick, mortar, or other incombustible material, wherever practicable, from the bottom of the joists to 6 inches above the top of the finished floors at each floor level. Such filling material shall extend entirely around the building and occupy the entire space between the two coverings. If necessary, horizontal wood braces, not less than 2 inches thick, shall be introduced between the joists or other wall timbers for the support of such filling.

In general, it will be seen that the present building code covers many of the points ordinarily considered in the rat-proof building ordinances. It does not, however, differentiate as such ordinances ordinarily do between buildings of different potential rat-harboring dangers. Such ordinances usually require stricter rat proofing in establishments which may be classified as large food depots and stables, which experience has shown are the main sources of rats and the greatest danger from a plague point of view.

THE PROPOSED BUILDING CODE.

This is an ordinance to repeal and reordain with amendments ordinance No. 155, approved June 19, 1908, from which the above quotations were made. The ordinance is at the present time under consideration by the city authorities. Some quotations from it which have a bearing on rat proofing and plague prevention follow, together with remarks upon them.

Section 3, paragraph 7, includes among the duties of the building inspector the determination as to whether defects or impairments which exist in building shall endanger the health of the occupants or menace surrounding property, and authorizes the building inspector to take action to correct conditions. Certainly this broad power covers rat proofing for plague prevention.

Section 10, paragraph 7, defines a basement as a story partly underground, but having at least one-half of its height above the curb level or the highest level of the adjacent ground.

Section 10, paragraph 30, states that fireproof construction shall apply to all buildings in which the principal parts are made of incombustible materials, including wood covered by a fireproofing.

Section 10, paragraph 32, defines the first story as the lowest story of a building if more than one-half the height of the story in the clear is above the level of the street. If there is a basement or cellar in the building, the terms shall apply to the story above the basement or cellar.

Section 10, paragraph 35, has the same definition for frame building as the old code.

Section 15, paragraph 1, prohibits frame buildings or other wood structures within the new fire limits as defined, which includes all of the thickly built-up districts.

Section 15, paragraph 5, provides that outside of the fire district there shall be a space of at least 20 feet between frame buildings. This proviso is of interest in that if owners should happen to have elevated frame buildings, this 20-foot space will assist in admitting light under the buildings.

Section 17, paragraph 1, states that in plain concrete the proportions shall not be less than 1 : 2½ : 5.

Section 18 defines cinder concrete, permits its use where not required to carry loads, and defines its proportion as 1 of cement, 2 of sand, and 4 of cinders.

Section 21, paragraph 3 G: The tops of all wooden piles, except those for wooden frame structures, shall be cut off at a point not more than 12 inches above mean low tide.

Section 24, paragraph 1: Foundation walls shall be built of masonry, reinforced concrete, or steel protected by masonry. All masonry foundation walls shall be laid in cement mortar. The proviso for cement mortar shall be thoroughly enforced, as an admixture of lime is commonly used, which results in mortar through which rats sometimes make holes. Paragraph 3 of section 22 provides that cement mortar for work below grade shall be one part cement and three parts sand. Section 23, paragraph 1, part E, provides that stone walls shall be laid in cement mortar and all spaces and joists shall be completely filled.

Section 29, paragraph 16, states that the footing bearings shall not be less than 3 feet below the surface, except for frame buildings. The same remarks apply here as noted in regard to the old code.

Section 30, paragraph 1: The flooring of the cellar or lowest story of dwelling, multiple dwelling, and every building in which manufacturing is carried on shall be made of concrete not less than 3 inches thick with the top finish of 1-inch mortar. It should be noted that this does not cover stables, restaurants, and food depots, which this requirement should be made to cover.

Section 30, paragraph 2, states that wood floors may be laid in such cellars or lowest floors, but in such cases the wood sleepers shall be placed on top of the concrete, which again is poor rat proofing. The sleepers should be embedded in the concrete, and the space between the wood floors and the concrete should not exceed one-half an inch.

Section 37, paragraphs 1, 5, and 7, cover construction of sheds which may be erected for the storage of materials or the shelter of workmen, animals, or for out-door manufacturing, and for temporary purposes, but for no other purpose. If within the fire limits, walls and roofs shall be made entirely of incombustible material. No permit shall be issued for any construction named in this section unless the same shall first be approved by the commissioner of health. This gives the health commissioner control over the group of buildings which have been found to cause a great deal of trouble in the plague campaign operations.

Section 38, paragraph 1: The footings for foundation walls for frame buildings built on the ground shall be laid out not less than 3 feet below the lowest surface of the ground.

Section 38, paragraph 14: The wall space in frame buildings is to be filled in the same manner as in the previous code. This provision should be thoroughly enforced.

Section 39, paragraph 30: This is the only paragraph specifically covering rat proofing of cellars of dwellings, and states that all floors to cellars and basements in dwellings must be not less than 3 inches of cement and the space between joists shall be brick-nogged or cement-nogged to the faces of walls and width of girders and to top of joists. All frame partitions and walls shall be brick-nogged or cement-nogged, solidly filling all space between studs to the height of 6 inches.

Section 39, paragraph 51: Whenever any dwelling, or any building, structure, excavation, business pursuit, matter or thing, in or about a dwelling, or the lot on which it is situated ——— is in the opinion of the commissioner of health dangerous or detrimental to life or health, the commissioner of health may declare that the same, to the extent that he may specify, is a public nuisance and may order that the same be removed, abated, suspended, altered, or otherwise improved, or purified, as his order shall specify. This paragraph would, as in case of a similar paragraph in the old code, give the health commissioner authority in times of plague epidemics to cause the rat-proofing of nonrat-proof buildings.

Section 43, paragraph 1: Again grain elevators are excepted from the provisions of the code. This should not be so, as they are most important from a rat-control point of view. They always require special attention in rat proofing.

Section 47, paragraph 8, provides that all wooden buildings shall be raised up or underpinned if they are below the level of the pavement or street. This raising is a standard form of rat proofing, and all instances of low-lying wooden buildings should be thus treated.

Section 47, paragraph 9, provides for the removal of sheds used as stables upon notice from the mayor.

DISCUSSION OF BUILDING CODES.

(1) In this code, as in the present one, food-handling establishments and stables are not included in the provisions, indicated in the above discussion, which cover rat proofing.

(2) Small outhouses, which are an especially dangerous rat harborage, may be rat proofed by lifting them off the ground onto piers admitting light under the building, but providing that the area under the building be maintained free from trash and materials.

(3) Double walls, ceilings beneath upper-story floors, and so-called "unnecessary spaces," i. e., boxed-in dead spaces, in buildings, especially in food-handling establishments, are always potential rat dangers. They can best be handled by opening them up, but if they must remain for protection against cold, all angles between floors and walls should be flashed with metal.

(4) Lumberyards, wood yards, and junk yards are always a problem in the rat proofing of any community. The best way to get the desired results is to insist on keeping the ground areas of them clean, free from trash, and by elevating the stored material so as to prevent rats harboring and nesting beneath it.

None of the subjects discussed in the three preceding paragraphs are covered by the codes.

RECOMMENDATIONS REGARDING THE BUILDING CODES.

Two general recommendations in regard to the building codes may be made:

(1) That certain minor changes, as noted in the discussion of the various sections and paragraphs of the codes, be made. This can very easily be done before the adoption in final form of the proposed code.

(2) That there be incorporated into the code requirements meeting the needs indicated in paragraphs 1, 2, and 3 in the preceding discussion of building codes. I believe that there exists in Baltimore at the present time a rat menace so dangerous as to warrant the

execution at once of these provisions. If enforced, the results would certainly justify their adoption.

It is doubtful if it is wise at this time to consider the rat proofing of lumber, wood, and junk yards. In the presence of an outbreak, however, provision would have to be made for them as indicated.

PROVISION FOR RAT PROOFING ENFORCEMENT.

There already exist in Baltimore in the building inspector's forces the essentials for the enforcement of the provisions for rat proofing the community. Unfortunately, however, a large portion of the buildings in the city were built prior to the 1908 code.

It may be recommended as follows:

First. That all of the existing provisions, some of which are noted above in regard to rat proofing, should be thoroughly enforced by the building inspector's forces.

Second. That within the city building inspector's forces one or two inspectors be especially trained in the methods of rat proofing, bearing in mind that it is especially necessary to pay attention to the most minor details of construction.

Third. That in order to aid property owners desiring to rat proof their buildings and to urge owners of buildings that should be rat proofed to do so, there be employed in the force of the building inspector's office an energetic, competent, trained inspector who by his personality and his endeavors may be able to give such assistance and secure such improvements where it would be impossible to secure a thorough enforcement of the existing laws.

Fourth. Such inspectors should be considered as a nucleus of a larger rat-proofing force that would be absolutely necessary and essential in an outbreak of a rat plague, which would not be advisable at the present time but should from time to time develop within this department.

SUMMARY OF FINDING AND RECOMMENDATIONS.

Baltimore has a numerous rodent population of mixed species, with apparently a predominance of the ground rat along its irregular shore line.

The economic damage done by these rats, while of unknown extent, is in the total very great.

There is a potential health danger in the presence of these rats as possible transmitters of bubonic plague, and while this danger is at present unknown, there are means whereby it may be determined and the following recommendations provide these means:

1. There should be established in the health department a squad of rat trappers, about eight in number, under a competent, trained

foreman, who shall systematically trap given areas of the city, primarily along the water front and dumps. This squad should be considered primarily for the purpose of securing rats for examination for the presence of plague and not for the purpose of eliminating rats from any given building or area.

2. The efforts of all other agencies concerned with the destruction or collection of rodents should be coordinated with this force so that all such rodents may be secured for this examination and so that their source of origin may be known.

3. A suitably equipped laboratory should be provided in the health department, in charge of a laboratory chief, with a laboratory assistant and a clerk.

4. Means should be provided in the health department for the transportation to the laboratory of all collected and trapped rodents.

Such laboratory and trapping forces should be considered a nucleus for further expansion as the need, either economic or health, is shown for them and funds may be available. In the presence of an epidemic of plague a force of some 20 or 30 laboratory workers and from 300 to 400 trappers would probably be required.

As a means of controlling the propagation of rats and of limiting their depredations, the following recommendations regarding the rat proofing of a community are made:

5. Strict enforcement of the provisions, as noted in the body of this report, of the present or proposed building codes should be made.

6. One or more of the inspectors of the building inspector's department should be detailed with the general supervision of these enforcements in all new constructions.

7. One energetic, competent inspector in the building inspection department should be detailed to assist those who may request it and to stimulate and urge those whose property may need it to rat proof buildings.

8. There should be enacted legislation covering the methods and enforcement of rat proofing of such properties as are not now covered by laws, namely:

(*a*) Food-handling establishments and stables to be rat proofed by strict compliance with the provisions of the building code, covering: Cement floors, side walls of the building extending into the ground at least 3 feet.

(*b*) Small outhouses which may be rat proofed by lifting them off the ground, admitting light under them.

(*c*) The elimination in all food-handling establishments and stables of all double walls, ceilings beneath upper-story floors, and so-called unnecessary spaces; or if these can not be eliminated, then the flashing of all angles between floors and walls with metal.

Such inspectors, recommended in paragraphs 6 and 7, should be considered as a nucleus, to be subsequently expanded as needed and as funds may be available. For campaign epidemic purposes 40 or 50 such inspectors would be needed.

Proper, complete collection and disposal of garbage is necessary to effect rodent control. It is not within the province of this report to discuss this situation in Baltimore.

It is not advisable to recommend for the present any other method of rodent capture or destruction.

In the presence of an outbreak of bubonic plague provisions would at that time have to be made for the proper fumigation of suspected or proven infected buildings and for the systematic destruction of all rodent harborages.

It is not considered that it falls within the province of this report to discuss provisions of a plague campaign, the details of which would frequently change during the progress of an outbreak, and which, if stated at this time, might have to be modified in the light of subsequent researches before they would be needed in Baltimore. It is believed, however, that all of the provisos and recommendations of this report are based upon thoroughly established facts which will not be subject to change in the execution of these recommendations, will not only assist in the control of the rodent infestations now present in the city as an economic and possible health danger, but will also place at the disposal of the authorities the nucleus of a force, which, if plague be found within the city, can be expanded at that time into a campaign organization. At that time further provisions can be made for the means which may then seem best suited to further meet the conditions presented by the outbreak.

RELATED PUBLICATIONS.

Available reprints and bulletins on rats and rat proofing, issued by the Public Health Service, from which copies may be obtained without cost:

PUBLIC HEALTH BULLETIN.

No. 103. The rat. Arguments for elimination and methods for destruction. 1919.

REPRINTS.

No. 86. The rat guard used in the Philippines. By Carroll Fox. June 7, 1912.

No. 91. Antirat ordinances of San Francisco, Calif., Oakland, Calif., and Seattle, Wash. August 16, 1912, and August 23, 1912.

No. 94. Notes on the bionomics of rats and ground squirrels. By George W. McCoy. July 5, 1912.

No. 132. Fumigation of vessels for the destruction of rats. By S. B. Grubbs. June 20, 1913.

No. 149. Rat proofing a municipal sewer system. Investigation in San Francisco. By Friench Simpson. October 31, 1913.

No. 182. Ship rats and plague. April 17, 1914.

No. 278. The migratory habits of rats. With special reference to plague. By R. H. Creel. June 4, 1915.

No. 281. Note on a rodent plague focus. By W. C. Rucker. June 11, 1915.

No. 357. Diagnosis of plague in rats. Microscopic examinations of rats supplementary to the microscopic examination. By C. L. Williams. August 18, 1916.

No. 423. Rodent destruction on ships. Relative efficiency of fumigants as determined by subsequent intensive trapping. By R. H. Creel and Friench Simpson. September 7, 1917.

No. 620. Information concerning rat surveys and rat proofing. With a model building. November 5, 1920.

No. 655. A guide to the proper rat proofing of buildings. C. E. Hauer. April 29, 1921.

No. 709. Natural immunity of wild rats to plague. By R. R. Spencer, November 18, 1921.

ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
10 CENTS PER COPY
▽

TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 122
JUNE, 1922

PUBLIC HEALTH ADMINISTRATION IN ARIZONA

By

Passed Assistant Surgeon R. C. WILLIAMS
United States Public Health Service

Prepared by Direction of
THE SURGEON GENERAL

LIBRARY OF THE HARVARD MEDICAL SCHOOL
A

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1922

TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 122
JUNE, 1922

PUBLIC HEALTH ADMINISTRATION IN ARIZONA

By

Passed Assistant Surgeon R. C. WILLIAMS
United States Public Health Service

Prepared by Direction of
THE SURGEON GENERAL

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1922

LIBRARY OF THE HARVARD MEDICAL SCHOOL

A32 B.1881.3, no 122

TABLE OF CONTENTS.

Page.

State board of health 2
  Composition of the board 2
  Meetings 2
  Salaries and expenses 2
  Powers and duties 2
  Superintendent of public health 3
  Personnel 4
  Vouchers and files 4
  Discussion 5
  Registration of births and deaths 7
  Registration of deaths 9
  Preventable diseases 11
  Infant mortality 12
  Discussion 12
  Registration of births 13
Report of diseases 14
  Requirements of law 14
  Requirements of regulations 14
  Absolute quarantine 16
  Modified quarantine 16
  Technical quarantine 16
  Methods of procedure 18
  Tuberculosis 19
  Typhoid fever 24
  Diphtheria 24
  Influenza 25
Accidents 25
Physical defects and diseases by the selective service draft examinations 25
Work of Child Welfare Bureau 26
Venereal disease control 27
Diagnostic laboratory 28
Local health authorities 30
  Requirements of law 30
  Phoenix 33
  Tucson 34
  Douglas 34
  Bisbee 36
  Discussion 38
Public health engineering 40
  Requirements of law 40
Inspection of food and drink 40
  Inspectors 41
Personnel of State laboratory 41
Annual report of examinations made by Arizona State Laboratory during 1920 42
Public health education 42
Health supervision of schools 43
Appropriations and expenses 44
Recommendations 45

PUBLIC HEALTH ADMINISTRATION IN ARIZONA.

By R. C. Williams,

Passed Assistant Surgeon, United States Public Health Service.

The following is the result of a study of the public health organization and activities in the State of Arizona. This study of public health work in Arizona was made at the invitation of the governor. It was begun on December 20, 1920, and completed March 28, 1921. The following towns were visited during the course of the study: Phoenix, Tucson, Douglas, Bisbee, Prescott, and Flagstaff.

Arizona has an area of 113,956 square miles; is divided into 14 counties and, according to the returns of the census of 1920, has a population of 334,162. The distribution of the population, according to color or race in 1920, was as follows: White, 291,449; Negro, 8,005; Indian, 32,989; Chinese, 1,137; Japanese, 550; all other (Filipino, Hindu, and Korean), 32. Of the total population 35.2 per cent is urban.

During the past 10 years the white population has increased by 70 per cent, while the Negro population increased by 298.5 per cent. The latter increase, however, was due chiefly to the presence of Negro troops in Arizona. The Mexican population comprises about 8 per cent of the total. The foreign-born white population numbered 78,099, constituting 23.4 per cent of the total population in 1920. These figures are from the report of the United States Bureau of the Census.

The largest county in the State has an area of 18,238 square miles; the smallest, an area of 1.229 square miles. The entire southern boundary of the State, 335 miles in length, forms a part of the international border between the United States and Mexico.

Several ranges of mountains traverse the State. Diagonally across the State from northwest to southeast are the Mogollon Mountains; in the southern part a range is found near the international border between Arizona and the Republic of Mexico. Numerous smaller ranges are found in various parts of the State. There are several points of considerable elevation. The highest town is 8,500 feet above sea level, the lowest 125 feet.

Few rivers are found; most of the land is desert. Within recent years, however, some of the desert land has been reclaimed for farming and grazing by irrigation.

The climate is dry and especially beneficial in the treatment of pulmonary conditions, particularly pulmonary tuberculosis. The winters in the central and southern sections at moderate elevation are salubrious. For this reason many visitors spend the winter months in Arizona. The many scenic wonders are an added inducement to visitors, as well as the pleasant winter climate.

The summer season in certain sections is warm; Yuma and Mohawk bear the distinction of being among the places having the highest recorded temperature in summer within the continental limits of the United States. The northern section of the State and other places with sufficient elevation are pleasant in summer.

The principal industries are mining, dairying, cattle and sheep raising, smelting and refining ores, farming in irrigated areas, and a small amount of dry farming. Cotton raising has become a very important industry within the past few years. There is some lumbering in the northern or wooded part of the State.

Acknowledgments are due, and are here made, to the governor, members and employees of the State board of health, local health authorities, and others for information and assistance received.

STATE BOARD OF HEALTH.

COMPOSITION OF THE BOARD.

The State Board of Health of Arizona consists of the governor, the attorney general, and the superintendent of public health. The governor is ex-officio president of the board, the attorney general ex-officio vice president, and the superintendent of public health is secretary.

MEETINGS.

The board is required to meet as often as once every six months at such place in the State as they may appoint.

SALARIES AND EXPENSES.

The president and vice president receive no compensation, but are paid 10 cents for every mile actually and necessarily traveled by them in the performance of their official duties, and other necessary expenses incurred by them.

POWERS AND DUTIES.

The powers and duties of the State board of health are:

1. To fix a time and place of the meetings of the board, subject to the provisions mentioned above.

2. To make rules and regulations for the government of the board, its officers, and meetings.

3. To make and enforce all needful rules and regulations for the prevention and cure and to prevent the spread of any contagious, infectious, or malarial diseases among persons and domestic animals.

4. To establish quarantine and isolate any person affected with any contagious or infectious or epidemic or endemic disease.

5. To isolate, kill, or remove any animal affected with contagious or infectious disease, when necessary to protect the public health.

6. To remove, or cause to be removed, any dead, decaying, or putrid body, or any decayed, putrid, or other substance that may endanger the health of persons or domestic animals.

7. To condemn, or cause to be destroyed, any impure or diseased article of food that may be offered for sale.

8. To superintend the several boards of health in the cities and towns and the county boards of health of the several counties.

9. To empower and direct the superintendent of public health to do, or cause to be done, any and all of the things mentioned above in subdivisions 4, 5, 6, 7, and 8.

10. To make such rules and regulations as it may deem necessary to govern the preparation of dead bodies for transportation, and to govern what classes of dead bodies may be transported, and the manner thereof.

11. To have charge of the registration of births and deaths and to enforce with uniformity and thoroughness the vital statistics law throughout the State.

12. To render to the governor biennially a report of work done.

SUPERINTENDENT OF PUBLIC HEALTH.

The superintendent of public health is required to be a practicing physician of the State, who is nominated by the governor, and by and with the consent and advice of the senate is appointed for a term of two years. The superintendent of public health is secretary of the State board of health, and is required to keep a record of the proceedings of the board and to perform such other duties as the board may direct or as are prescribed by law.

The records kept by the superintendent of public health are to be at all times open to the public. The superintendent of public health is also State registrar of vital statistics, and is charged with the proper execution and enforcement of this law; he is further charged with the enforcement of the law requiring proper bathrooms, water-closets, and change rooms at certain industrial establishments. The administration of the law designed to prevent the adulteration of food or drink is also placed in the hands of the superintendent of public health. The actual prosecution of violations of this law is vested in the county attorney of the county in which the offense occurs.

PERSONNEL.

The personnel of the State health organization (exclusive of the membership of the board), with their respective annual salaries, is at present as follows:

Superintendent of public health (part time)	$1,000
State registrar of vital statistics (part time)	1,000
(Superintendent of public health required by law to be State registrar.)	
Director of bureau of venereal disease control (part time)	1,800
(Also full-time health officer of city of Douglas, for which additional compensation is received.)	
Director of surveys and inspection (full time)	3,000
Director of child welfare (full time)	1,200
Secretary to superintendent of public health	2,100
Statistical clerk	1,800
Public-health nurse (local work in only one town)	1,680
Clerk	900
Total	14,480

Office hours of the State board of health are from 9 a. m. to 5 p. m., with one hour for lunch. On Sundays and holidays the office is closed. Under the present arrangement the office is frequently left without anyone at the lunch hour. This should be changed so as to always have one employee in the office at the usual lunch hour.

VOUCHERS AND FILES.

Expenditures are made at the direction of the superintendent of public health. Bills for expenditures and salaries are audited and approved in the office of the superintendent of public health and attached to properly prepared vouchers, then forwarded to the State auditor for payment.

The State auditor prepares a warrant for the correct amount and transmits it to the office of the State board of health. There a notation is made of the amount and number of the warrant. It is then sent to the proper claimant.

The fiscal year of the State is from July 1 to June 30; all of the business of the office is conducted on this basis with the exception of the payment of accounts for fees with local registrars. The settlement of accounts with local registrars should be changed to correspond with the other work of the office; that is, at the end of the State fiscal year. The accounting of expenditures of the State board of health should also be arranged so as to show at a moment's notice the amount expended by any bureau or division.

The letter-filing system used is by subjects and individual names.

DISCUSSION.

As organized under the present law, the State board of health changes its membership with each change in the State officials. The general State election is held every two years, at which time the governor and attorney general are elected. They constitute the fixed members of the board. The superintendent of public health is a part-time official, his term of office being arranged to expire shortly after each succeeding set of State officials enter office. The superintendent of public health is appointed by the governor, with the advice and consent of the senate. This allows each governor to appoint a superintendent of public health. Thus it may occur that for political reasons the superintendent of public health may fail of reappointment, and the State may lose an efficient health officer. The law should be amended to remove the State board of health from direct political influence or changes.

The administration of the public health laws of the State should be delegated to a State health commissioner, who should be a full-time man. He should be expected to formulate plans and regulations, also provide the necessary technical information to the advisory board.

Public health administration to be effective must be done by a single executive, who must in turn be responsible to an advisory board. He should have an advisory board for the performance of judicial duties devolving upon the State health department. To such an advisory board the State health commissioner should be subordinate and held to account for the proper performance of his official duties.

A board composed of three persons, including one physician, would be a suitable number, the State health commissioner to be a member ex officio. This board should be composed of representative public-spirited citizens, and as the services rendered by them would be beyond recompense, no remuneration should be provided, except the actual and necessary traveling expenses allowed other State officials. Members of the board should be appointed by the governor for a term of six years, so arranged that a vacancy would occur every two years.

The State health commissioner should be required to devote all of his time to the duties of the office and should not be allowed to practice medicine, or have any other outside interests that would consume time from official duties. In return for his services the State health commissioner should be paid a salary in keeping with the duties and responsibilities of the office. The executive head of any State health department is a place of sufficient importance and responsibility to demand all of that official's time for the duties of the office.

TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 122
JUNE, 1922

PUBLIC HEALTH ADMINISTRATION IN ARIZONA

By

Passed Assistant Surgeon R. C. WILLIAMS
United States Public Health Service

Prepared by Direction of
THE SURGEON GENERAL

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1922

The reasons for having the local registrars submit their reports to the county registrars and not directly to the State registrar may be summed up as follows:

1. The county superintendent of public health should be conversant with the vital statistics of his county. This can best be accomplished by having the original reports pass through his hands.

2. The work of local registrars can best be superintended by some one in the county.

3. In States like Arizona, where many of the counties are large, some of them as large as an average Eastern State, the matter of obtaining local registrars is a serious problem in the sparsely settled areas. This matter of appointing local registrars for thinly populated districts can certainly best be handled by a person in the county. Several of the local registrars in Arizona have territories of 500 or 600 square miles. One local registrar has a territory of 11,000 square miles; however, more than 10,000 square miles of this area is uninhabited desert. The remaining 1,000 square miles is thinly settled.

In order to obviate the difficulty experienced in getting prompt and accurate returns from the county registrars, several plans may be adopted. Local registrars could be instructed to submit promptly to the State registrar a list of the birth and death certificates transmitted to the county registrar each month. The State registrar would then be able to check up the returns of the county registrar against the lists submitted by the local registrars. Or the law could be amended to authorize the State board of health to remove unsatisfactory county and local registrars, as the county board of health is now authorized by law to remove local registrars who are derelict in the performance of their duties.

The law very clearly defines what is to constitute a primary registration district, and provides for registration within incorporated towns, cities, and the parts of counties outside the incorporated limits of cities and towns. There is no authority for a local registrar of a city or town to register any births or deaths, save those occurring within the town or city for which he is local registrar. Such practice has become established, however, and the local registrars for all of the cities and towns report births and deaths occurring in the territory surrounding the cities or towns.

This practice is not only contrary to the provisions of the vital-statistics law, but it confuses births or deaths occurring within incorporated towns with those reported from the surrounding rural or suburban areas. The county registrar for each county should be required to appoint a local registrar for each city or town in the county.

In the territory adjacent to the towns or cities a sufficient number of local registrars should be appointed to properly perform this work.

As a specific example of the confusion arising from the present plan, the following is cited: During this study it was desired to compare the vital statistics reported in the more important towns with those from the State at large. Inquiry developed the fact that the local registrars of the several towns also recorded births and deaths for a large area surrounding the towns. In most cases no effort is made to keep the rural reports separated from those occurring in the city proper.

The local registrar for the city of Phoenix recorded 981 births and 1,151 deaths in 1919, but only 585 of the births and 658 of the deaths actually occurred in Phoenix. The remainder occurred in the rural area surrounding Phoenix. There should be separate local registrars to record the rural statistics occurring near the towns.

In the city of Tucson 622 births and 771 deaths were recorded in 1920, but the local registrar did not record the rural statistics separately from those for the city; hence, the only way to obtain the correct birth and death rates for Tucson is to go through the reports filed and separate the rural from the city. Only a few of the towns keep the rural statistics separated from the urban. This practice should be discontinued and local registrars should be appointed for the territory surrounding the towns.

REGISTRATION OF DEATHS.

For the 12 months ending December 31, 1919, 5,040 deaths were registered with the State registrar, exclusive of stillbirths, making the death rate for the State for the year 1919, 15.08 per thousand. For the period of 12 months ending December 31, 1920, there were recorded with the State registrar 5,325 deaths, stillbirths excluded. The death rate for the State for 1920, based on these statistics, is 15.90 per thousand.

Arizona is well known as having a desirable climate for persons affected with tuberculosis. The low humidity of the atmosphere, moderate elevation, and mild winters, particularly in the central and southern parts, attract many persons who are suffering from pulmonary tuberculosis. Because of the climate, many individuals who have contracted tuberculosis elsewhere come to Arizona seeking health. In reviewing the death rate of the State it would, therefore, seem fair to exclude those deaths from tuberculosis where the disease was contracted outside the State.

In order to obtain an estimate of the annual number of deaths from tuberculosis contracted elsewhere it was necessary to tabulate from the death certificates for a specified period the State in which the disease was contracted. The total number of reported deaths in Arizona from all forms of tuberculosis for the year 1919 was 1,104. Of this number 238, or 21.55 per cent, gave Arizona as the place where the disease was contracted; 412, or 37.33 per cent, are stated as having contracted the disease in places other than Arizona. For 454, or 41.12 per cent, the place where the disease was contracted is unstated.

During 1920 there were 1,253 recorded deaths from all forms of tuberculosis; 237, or 18.89 per cent, were stated as having contracted the disease in Arizona; 502, or 40.07 per cent, gave other States or countries as the place of origin; and 514, or 41.04 per cent, were unstated.

	1919	1920
Total number of deaths, all forms of tuberculosis	1,104	1,253
Number stating Arizona as the place contracted	238	237
Number giving other States or countries as place contracted	412	502
Place disease contracted not stated	454	514

In reports of deaths from all forms of tuberculosis, Arizona was given as the place of origin in 1919 of 21.55 per cent, in 1920 of 18.89 per cent. An average, as shown by these percentages, is 20.22 per cent. However, it must be kept in mind that a large number of the deaths reported failed to give the place where the disease was contracted. Therefore, 20.22 per cent is apparently slightly lower than the actual percentage of deaths from tuberculosis contracted in the State.

It is fully realized that statistical data from death certificates is sometimes misleading, and that faulty conclusions may be drawn from data as above derived. With all this in mind, and in consideration of the observations made during this survey, also of the opinions of persons in the State familiar with actual conditions, it is thought fair to assume that in about 23 per cent, or 1 out of every 4½ deaths from tuberculosis in Arizona, the disease was contracted within the State.

Reasoning on the basis that 77 per cent of the deaths occurring from tuberculosis are contracted elsewhere, we are justified in subtracting 850 from the total of 1,104 reported deaths from tuberculosis in 1919, and 963 from the 1,253 such deaths reported in 1920. This leaves the actual number of reported deaths from tuberculosis contracted in Arizona for 1919 as 254, and for 1920 as 290. Therefore, the corrected death rate for tuberculosis appears to be 0.76 per 1,000 for the State in 1919 and 0.87 per 1,000 in 1920. In comparison with the corrected tuberculosis death rate with the tuberculosis death rate in States near by it is found that for 1919 the Arizona rate is 0.76 per 1,000; Kansas, 0.50; Utah, 0.44; Montana, 0.89. The States of California and Colorado, both of which have a large tuberculous population from other States, had rates of 2.15 and 1.75, respectively. It is believed that this tends to support the estimate that approximately 23 per cent of those who died of tuberculosis in the State contracted the disease in Arizona.

The corrected death rate per 1,000 for all causes for the State in 1919 is 12.57, and for 1920 is 13.03.

	1919	1920
Crude annual death rate per 1,000 for tuberculosis for the State	3.27	3.74
Estimated annual death rate per 1,000 for cases of tuberculosis arising within the State	.76	.87
Crude annual death rate per 1,000 for all causes for the State	15.08	15.90
Corrected annual death rate per 1,000 from all causes for the State	12.57	13.03

With a view to making an approximate estimate as to whether the State is obtaining satisfactory death registration, an effort was made to obtain figures for six or seven towns of the State where it is believed that fairly complete death returns are recorded. Upon investigation it was found that only one or two towns of the State keep accurate records of the births and deaths occurring in the city or town proper. All of the other towns recorded the births and deaths from the adjacent rural or suburban areas with those occurring in the town. Therefore it is impossible to compare the registration of births and deaths in the towns of the State with the rate of the State at large.

Previous reference has been made to this reprehensible practice of recording the vital statistics of adjacent rural areas with the town or city. Emphasis is again placed upon the fact that births and deaths occurring in the rural territory around towns should be registered by local registrars for such rural areas and never by a city local registrar. This practice not only destroys the value of the vital statistics for such towns but it causes the confusion of records that should be entirely distinct. Local city registrars should be forbidden to record any births or deaths, except those occurring within their town or city. A sufficient number of rural local registrars should be appointed for the area surrounding the towns and cities.

The registration of deaths in the State, although improving, can by no means be said to be complete.

Death certificates are card-indexed alphabetically and bound alphabetically by counties for each year.

PREVENTABLE DISEASES.

A study of the causes of death, shown on the 5,040 certificates of death registered for the 12 months ending December 31, 1919, shows that of this number 3,042 deaths may be considered as preventable in the usual sense of the word. But of these 3,042 deaths, 1,104 were due to tuberculosis, and of these, according to our estimate already given, 850 contracted the disease outside the State, leaving approximately 250 as the number of the deaths which may be ascribed to the State. This is 52 per cent of all the deaths after making deductions for tuberculosis contracted outside the State. A similar percentage for 1920 is 47.

Disease.	1919				1920			
	Total deaths recorded for 1 year, all ages.	Indicated annual death rate per 100,000.	Total number cases reported.	Indicated fatality rate per 100 cases.	Total deaths recorded for 1 year, all ages.	Indicated annual death rate per 100,000.	Total number cases reported.	Indicated fatality rate per 100 cases.
Typhoid fever	44	13.16	44	100.00	33	9.87	87	37.93
Measles	5	1.49	68	7.35	23	6.88	295	7.79
Scarlet fever	2	.59	33	6.06	1	.29	186	.54
Whooping cough	8	2.36	29	27.56	25	7.84	89	28.08
Diphtheria	21	6.32	47	44.68	27	8.07	90	30.00
Influenza	189	50.54	3	....	129	36.20	1,736	74.30
[1] Pulmonary tuberculosis	1,030	308.23	88	....	1,169	349.30	155	....
[1] Other forms of tuberculosis	74	22.14	0	....	84	25.13	0	....
Syphilis	32	9.57	71	45.00	23	6.88	130	17.68
Pneumonia (not bronchial)	688	205.88	1	....	490	146.63	78	....
Meningitis (exclusive of tubercular)	45	13.16	2	....	47	14.65	3	....
Diarrhoeal diseases (under 2 years)	528	158.07	....	....	537	160.70	....	....
Malignant growths	107	32.03	....	....	130	38.93	....	....
Puerperal septicemia	28	8.67	....	....	19	5.68	....	....
Other puerperal accidents	13	3.89	....	....	25	7.84	....	....
Mines and quarries	47	14.65	....	....	42	12.56	....	....
Other accidents	181	54.16	....	....	194	58.05	....	....
Total	3,042	....	386	....	2,998	....	2,749	....

[1] Includes those cases contracted outside of the State.

INFANT MORTALITY.

During the two 12-month periods ending December 31, 1919 and 1920, there were 1,015 deaths in 1919 and 1,224 in 1920, of children less than 1 year of age, exclusive of stillbirths (243 stillbirths in 1919 and 275 in 1920). This is 15.38 per cent of the births for 1919 and 15.23 per cent of all births for 1920. Based on such statistics, the infant mortality would appear to be slightly more than one of every six born. One child of every six born in Arizona dies before reaching the age of 1 year.

REGISTRATION OF BIRTHS.

The records show that for the 12 months ending December 31, 1919, 6,591 births were registered, giving a birth rate of 19.71 per 1,000 per annum. For the 12 months ending December 31, 1920, 8,045 births were recorded, with an annual birth rate of 24.04 per 1,000. This shows an increase of 1,456 registered births, or 18 per cent more than in 1919. Such an increase shows greater efficiency in administration of the law and more interest on the part of the citizens of the State in vital statistics. Taking the State as a whole, it appears that the rate for 1920 is still somewhat below the rate to be expected.

It is no doubt true that a number of births that occur are not recorded; however, there has been a marked improvement in the registration of births during the past two years. Prior to this the number of deaths recorded exceeded the births. Efforts of the Bureau of child welfare have been directed toward interesting physicians, midwives, and mothers in a more accurate registration of births. For each birth certificate that is received by the State registrar, a card is sent out by the child welfare bureau of the State board of health, informing the mother that the birth of the child has been recorded. If the child was unnamed at the time the birth certificate was filled out, attention is invited to this fact and a blank is inclosed upon which a supplementary report of the name of the child may be made. Literature on the care of infants is also forwarded to the mothers. This plan has assisted in arousing interest throughout the State in birth registration. It would appear that the work of acknowledging the registration of birth certificates, also follow-up work in obtaining names of children reported unnamed, is logically the duty of the bureau of vital statistics, rather than the bureau of child welfare.

The birth certificates are indexed alphabetically by counties for a given year and bound. All vital-statistics records are kept in a fireproof vault in the State capitol.

DISCUSSION.

As in the case of registration of deaths previously mentioned, the State health authorities complain of poor cooperation on the part of several of the county registrars in forwarding birth certificates. Methods for overcoming this difficulty have been discussed in connection with the comments on the registration of deaths.

The binding of many of the volumes of the birth and death certificates is very carelessly done. Many of the certificates are disarranged and out of their correct order. This fact was emphasized on several occasions when attempting to locate certificates in response to requests for certified copies. It was found in a number of instances that although the card index showed the certificate had been filed, the certificate could not be found, or was found entirely out of the proper place. All of the certificates now on record with the State board of health should be very carefully rearranged, rebound, and reindexed.

The epidemiological activities of the State board of health are rather limited. The epidemiological work performed is done by the director of surveys and inspections and the director of the State laboratory. The director of surveys and inspections is not a medical man, but is experienced in handling tuberculosis problems. The most important work done by the director of surveys and inspections consists of surveys in various parts of the State with reference to the distribution and prevalence of tuberculosis. The State board of health, although paying all of the salary received by the director of surveys and inspections, permits this official to give a large part of his time to duties as State secretary for one of the nonofficial agencies interested in the control of tuberculosis.

The director of the State laboratory is not a physician, but is well trained in bacteriological and chemical methods and has had some experience in epidemiological work. Because of lack of funds and insufficient assistance in the laboratory, the director of the State laboratory can devote but little time to field work for the State board of health.

REPORT OF DISEASES.

REQUIREMENTS OF LAW.

Whenever it shall come to the knowledge of any physician or other person that a contagious, epidemic, or infectious disease exists within the jurisdiction of any local board he shall immediately report to such board in writing the name and place of residence, if known, of every person afflicted with such disease, and if he is the attending physician of such person he shall report not less than twice each week the condition of each person so afflicted and the state of such disease.

REQUIREMENTS OF REGULATIONS.

Every physician who shall know or suspect that any person requiring his or her services professionally is suffering from any of the diseases required by regulations to be reported shall forthwith make report to the local board of health. The report shall be personally signed by the physician and contain such items of information as are indicated by the blanks. Cases merely suspicious or suspected shall be so reported, and the local board shall be promptly notified as soon as a definite decision is made as to the nature of the disease.

The law provides that a penalty of not less than $10 or more than $50, or by imprisonment in the county jail not exceeding 30 days, or both, for persons who secrete contagious or infectious diseases, also for physicians who fail to report same, or health officers who neglect their duties relating to the control of such diseases.

Under regulations of the State board of health the following diseases are declared to be communicable and dangerous to the public health and are required to be promptly reported to the local board of health:

Bubonic plague.
Chancroid.
Chickenpox.
Cholera (Asiatic or epidemic).
Dengue.
Diphtheria (diphtheritic croup or diphtheritic sore throat).
Epidemic cerebrospinal meningitis.
German measles.
Gonorrhea.
Hydrophobia (rabies).
Infantile paralysis.
Influenza.
Leprosy.
Malarial fever.
Measles.
Relapsing fever.
Scarlet fever (scarlatina or scarlet rash).
Smallpox (variola, varioloid).
Syphilis.
Tuberculosis.
Typhoid fever.
Typhus fever.
Whooping cough.
Yellow fever.

The regulations also provide that every keeper of a private house, boarding house, lodging house, or hotel must report the above diseases to the local board of health if such cases have not been attended by a physician.

Cases of Asiatic cholera, bubonic plague, smallpox, and yellow fever, in addition to the card report, are required to be reported immediately to the local board of health by the most expeditious method (telephone, telegraph, or messenger). Except in cases of smallpox, the executive officer of the local board of health is required to promptly advise the State board of health by telephone or telegraph of the presence of these diseases. Like immediate notice, in addition to the card report, is also required to be made to the local board of health of primary cases in a community of any of the following diseases:

Chickenpox.
Diphtheria.
Measles.
Scarlet fever.
Whooping cough.

County superintendents of public health and local health officers are provided with forms upon which to make written reports to the State board of health, giving the necessary data relative to the reportable diseases.

Under the act creating the State board of health power is granted the board to promulgate and enforce all needful rules and regulations for the prevention and cure, and to prevent the spread of any contagious, infectious, or malarial disease among persons and domestic animals. Pursuant to the authority granted by this act, regulations for the control of communicable diseases were adopted on April 25, 1914; an amendment to include control of venereal diseases was added on January 11, 1918. These regulations, for the most part, are full and complete. The terms, absolute, modified, and technical quarantine are defined as follows:

ABSOLUTE QUARANTINE.

First. Absolute prohibition of entrance to or exit from a building or conveyance, except by officers or attendants authorized by the health authorities, and the placing of guards, if necessary, to enforce this prohibition.

Second. The posting of warning placards, stating the name of the disease, in a conspicuous place or places on the outside of the conveyance or building.

Third. The prohibition of the passing out of any object or material from the quarantined house or conveyance.

Fourth. Provision for conveying the necessities of life, under certain restrictions, to those in quarantine.

MODIFIED QUARANTINE.

First. Prohibition of entrance and exit, as in absolute quarantine, except against certain members of the family authorized by the health authorities to pass in and out under certain definite restrictions.

Second. The placing of placards as under absolute quarantine.

Third. Isolation of the patient and attendants.

The wage earner is allowed, under modified quarantine, to continue work, provided at no time he comes in contact with the patient, and that he has and uses facilities for thoroughly cleansing his hands immediately before leaving the premises. The privilege of continuing work is not extended to wage earners employed in the production, sale, or manufacture of candy or food products, including milk and ice cream, nor to teachers or others whose work brings them in intimate contact with children.

TECHNICAL QUARANTINE.

In cases of venereal diseases, this includes regularly reporting to a physician for treatment till discharged, and refraining from acts that would tend to infect others.

The following diseases are specified as requiring absolute quarantine:

Bubonic plague.
Cholera.
Smallpox.
Yellow fever.

Diseases requiring modified quarantine:

Diphtheria.
Epidemic cerebrospinal meningitis.
Infantile paralysis.
Influenza.
Measles.
Scarlet fever.

Technical quarantine is used in the control of the following diseases:

Chancroid.
Gonorrhea.
Syphilis.

Placards are required to be placed on houses where the following diseases are present; such placards must be dated:

Chicken pox.
German measles.
Leprosy.
Mumps.
Typhoid fever.
Whooping cough.

The size of the placards to be used and the wording of such placards are specifically prescribed in absolute quarantine and modified quarantine.

The quarantine regulations also set forth certain rules for the exclusion of children from school. Pupils actually affected with the below-mentioned diseases are excluded from school.

Quarantinable diseases previously mentioned:

Acute contagious conjunctivitis.
Erysipelas.
Favus.
Impetigo contagiosa.
Pediculosis capitis (head lice).
Pediculosis corporis (body lice).
Scabies (itch).
Tina circinata (ring worm).
Tonsilitis.
Trachoma.

The regulations of the State board of health further provide for the inspection of railroad cars, when necessary, and removal of persons suffering from quarantinable diseases to isolation or detention. The reports required of county superintendents of public health are also described.

Communicable diseases reported to the Arizona State Board of Health for 1919 and 1920.

Disease.	1919		1920	
	Cases reported.	Indicated annual incidence rate per 100,000.	Cases reported.	Indicated annual incidence rate per 100,000.
Chickenpox	40	11.97	116	35.01
Chancroid	3	.89	6	1.78
Diphtheria	47	14.65	90	26.93
Gonorrhea	279	83.49	330	98.70
Infantile paralysis	3	.89	3	.89
Influenza	3	.89	1,736	519.80
Leprosy			1	.29

Communicable diseases reported to the Arizona State Board of Health for 1919 and 1920—Continued.

Disease.	1919		1920	
	Cases reported.	Indicated annual incidence rate per 100,000.	Cases reported.	Indicated annual incidence rate per 100,000.
Malaria	2	0.59	2	0.59
Measles	68	23.46	295	88.28
Meningitis	2	.59	3	.89
Mumps	7	2.09	50	15.26
Malta fever	....	....	1	.29
Pneumonia	1	.29	78	23.34
Rabies	2	.59	....	....
Scarlet fever	33	9.87	186	55.66
Smallpox	69	20.64	176	52.96
Syphilis	71	21.24	130	38.90
Tuberculosis	88	26.33	155	46.38
Typhoid fever	44	13.16	87	26.03
Whooping cough	29	8.67	89	26.63

The prompt reporting of communicable diseases is absolutely necessary for their control and prevention. By keeping a close watch on the prevalence of these diseases and instituting vigorous measures when indications point toward any increase over the normal endemic index many incipient epidemics may be checked. Any community, county, or State may expect to have some cases of communicable diseases. Sporadic cases may occur in any community. The matter of importance is to impress upon physicians and the general public the urgent need of promptly reporting to the health authorities all cases of communicable diseases or the presence of any outbreak of disease not fully understood.

The above table indicates that the reporting of communicable diseases in Arizona is given but little consideration. The figures for 1920 show an improvement over those for the year previous. The statistics for gonorrhea, syphilis, and influenza show the value of special campaigns for encouraging the reporting of certain diseases.

METHODS OF PROCEDURE.

The office of the State board of health performs most of its functions by means of correspondence. Occasionally the superintendent of public health or some employee of the board goes on a trip for the purpose of making an investigation, delivering an address or assisting some local health officer. Inadequate appropriations and lack of the necessary full-time field force prevents the proper attention to even the more important public-health problems of the State.

Nature has endowed Arizona with a healthful climate and splendid natural resources, but even such advantages do not insure preservation of the health of its inhabitants unless there is also careful supervision of all matters of hygiene and sanitation.

From a public health standpoint the more important sources of disease are individuals sick with or recovering from communicable diseases, " carriers," impure and improper food, infected milk, polluted water, improper disposal of the human wastes, diseases arising from occupational environment, diseases transmitted from animals, and diseases of heredity. Efforts directed toward the improvement and safeguarding of the public health must, therefore, take cognizance of all these as well as other factors.

TUBERCULOSIS.

The records of the State registrar of vital statistics show that for the year 1919 there were 1,104 deaths from all forms of tuberculosis; in 1920 there were 1,253 deaths; 21.90 per cent in 1919 and 23.53 per cent in 1920 of all deaths in the State were due to tuberculosis. As has been previously shown in this study, it is thought fair to assume that in 77 per cent of all deaths from this cause occurring in Arizona the disease was contracted elsewhere. After making this correction, it appears that the correct death rate per 1,000 for cases of tuberculosis contracted in Arizona for 1919 is 0.76; in 1920, 0.87. The crude annual death rate per 1,000 from tuberculosis for 1919 is 3.27, and for 1920, 3.74.

The number of cases of tuberculosis in the State is not known. The rejection of draft registrants from Arizona because of tuberculosis was 66.58 per 1,000. When it is considered that a majority of the white persons in the State who are native Americans, but not natives of the State, have come to the State because of their own health or the health of some member of their family, it can be realized what a large number of active cases are present in the State. In passing it may be well to note that most of the foreign-born whites are employed in or around the numerous mining camps or smelters. Although a certain number of the foreign-born whites do come to Arizona as health seekers, the percentage is small.

The morbidity reports on tuberculosis are entirely inadequate. The director of surveys and inspections of the State board of health has conducted several surveys in different towns of the State with reference to various aspects of the tuberculosis problem.

Data at hand based on these surveys show that in the city of Phoenix in a canvas of 1,008 homes in all sections of the city there were 481 known cases of tuberculosis. This canvass did not include any tuberculosis camp or sanatoria. The results of this particular canvass may be further classified as follows:

Duration of residence in Arizona:	
Less than 1 year	259
1 to 3 years	98
3 to 5 years	33
5 years and over	91
Total	481
Distribution by sex:	
Adults—	
Male	260
Female	171
Children—	
Male	28
Female	22
Total	481
Distribution by race:	
White	428
Mexican	35
Negro	18
Total	481

In the city of Tucson a similar canvass was made, except a larger number of homes were visited, but unfortunately the exact number was not noted; 969 known cases of tuberculosis were recorded. None of the numerous camps or sanatoria were included; however, all parts of the city were visited. The Tucson cases are classified as given below:

Duration of residence in Arizona:	
Less than 1 year	401
1 to 3 years	207
3 to 5 years	174
5 years and over	187
Total	969

Of the 969 cases, 38 specified Arizona as the place where disease was contracted.

Distribution by race:	
White	822
Negro	28
Mexican	106
Indian	13
Total	969

In addition to the 969 known cases of tuberculosis recorded in this survey, 1,111 persons were found who had come to Tucson as health seekers for other reasons than known tuberculosis.

Classification of health seekers other than known tuberculous:	
Influenza convalescents	570
Pneumonia convalescents	108
Bronchitis	76
Asthma	139
Empyema	2
Enlarged glands with suspected tuberculosis	32
All other conditions	184
Total	1,111

Two thousand active cases of pulmonary tuberculosis is a very conservative estimate for Tucson.

The canvass made at Prescott showed 244 known cases of tuberculosis out of 1,121 persons interviewed and 332 homes visited in various parts of the town. No sanatoria or camps were included in this. The tabulation by residence and race is as follows:

Duration of residence in Arizona:	
Less than 1 year	92
1 to 3 years	53
3 to 5 years	20
5 years and over	79
Total	244

Distribution by race:	
White	185
Mexican	51
Negro	8
Total	244

Although many of Arizona's useful citizens came to the State as health seekers, and are now arrested cases, the economic burden placed upon the various communities by indigent tuberculous persons from other States is indeed quite serious. Many sick people reach Arizona who have only enough funds to sustain them for a short time; some come without any funds; numbers become dependent after a year or two. Physicians in other States little realize the load they place upon Arizona communities when they advise persons who are penniless or without sufficient means to seek health in this climate.

Arizona is desirous of sharing her splendid climate with all health seekers, but, quite naturally, does not care to acquire additional financial burdens while assisting those from other States in searching for health within her borders.

The prevalent popular idea that the climate of the arid Southwest alone can effect an arrest of pulmonary tuberculosis is difficult to eradicate. The climate is beneficial, but the usual régime of nutritious food, enforced rest, and careful medical supervision is as necessary for arresting tuberculosis in Arizona as elsewhere.

There are a number of private hospitals, sanatoria, and camps for the treatment of tuberculosis, but neither the State of Arizona nor any of the counties have provided public hospitals for the care of the tuberculous. Such a step would be an invitation to many indigent sufferers in other States. Six of the counties maintain hospitals for the care of the indigent sick and disabled of the county. The capacity of these general hospitals varies from 20 to 40 beds. All of the county hospitals provide a small number of beds for tuberculous patients. The other eight counties take care of sick indigents, including the tuberculous, by placing them in some hospital located in the county. Hospitals receiving such cases usually give the county a special rate.

A general health clinic is in operation in the two largest cities of the State—Phoenix and Tucson. Each of these health clinics is maintained by the cooperative efforts of local welfare societies and organizations interested in the control of tuberculosis. At these clinics persons unable to pay may receive free out-patient medical care, and in some instances, medicines. A number of tuberculous persons are given medical consultation and advice at these clinics.

Local physicians contribute their services to the health clinics. The State board of health contributes a part of the salary paid to one of the nurses employed at one of the clinics.

The more the tuberculosis problem in Arizona is studied the more plainly it appears to be a vast social and economic problem, as well as one of public health. The penniless health seeker who must have immediate financial assistance in order to obtain even the barest necessities of life is more a social or welfare problem than a matter for the attention of the health authorities.

The fact is well known that the North American Indian is very susceptible to pulmonary tuberculosis. There were in 1920 32,989 Indians in Arizona, of whom the greater number live on the several Government reservations. There are no recent statistics available for use in this study in estimating the prevalence of tuberculosis among the Arizona Indians.

In 1912, however, the United States Public Health Service made an investigation of the prevalence of trachoma, tuberculosis, and smallpox among the Indians of the United States. As a result of this investigation (published as Senate Document No. 1038) it appeared that, in Arizona, in 1912, out of 5,873 Indians examined, there were 114 cases of tuberculosis; namely, pulmonary 52, glandular 54, osseous 6, and other forms 2. A considerable proportion of the Indians examined, however, were boarding-school children. These had a low tuberculosis rate, as children with tuberculosis were excluded from the schools. The rate of infection seemed to vary in different parts of the State from 1.5 per cent among the White River Apaches to 14.6 per cent among the Walapai Indians.

Tabulation of deaths occurring in Arizona from all forms of tuberculosis in 1919 and 1920 with reference to State or country in which disease was contracted.

State or country.	1919			1920		
	Male.	Female.	Total.	Male.	Female.	Total.
Arizona	174	64	238	143	94	237
Alabama	4	1	5	2	3	5
Arkansas	6	2	8	10	3	13
California	34	28	62	29	20	49
Colorado	6	1	7	3		3
Connecticut				2	1	3
Florida	3	1	4	2	1	3
Georgia	3	1	4	6	3	9
Idaho	2	1	3	2	2	4
Illinois	23	9	32	21	15	36
Indiana	4	3	7	8	10	18
Iowa	3	1	4	7	1	8
Kansas	13	3	16	6	7	13
Kentucky	3	3	6	6	3	9
Louisiana	2	1	3	2		2
Maine				1		1
Massachusetts	1	1	2	2	1	3
Michigan	7	4	11	12	5	17
Minnesota	8	4	12	4	4	8
Mississippi	2	2	4	2	2	4
Missouri	17	9	26	16	10	26
Montana	5	4	9	6	1	7
Maryland	1		1	1		1
Nebraska	4	1	5	4	3	7
Nevada		1	1	1		1
New Jersey	1	1	2	4	2	6
New Mexico	2	1	3	3	2	5

Tabulation of deaths occurring in Arizona from all forms of tuberculosis in 1919 and 1920, with reference to State or country in which disease was contracted—Continued.

State or country.	1919			1920		
	Male.	Female.	Total.	Male.	Female.	Total.
New York	12	6	18	19	2	21
North Carolina	2	2	4	2		2
North Dakota	2		2	1		1
Ohio	13	7	20	20	7	27
Oklahoma	4	4	8	13	11	24
Oregon	5	1	6	13	2	15
Pennsylvania	12	4	16	14	5	19
Rhode Island	1		1			
South Carolina					1	1
South Dakota	2		2	2	3	5
Tennessee	9	3	12	7	4	11
Texas	19	12	31	12	6	18
Utah	2	1	3	1	1	2
Virginia	2		2	4		4
Washington	3	1	4	4		4
West Virginia	1	1	2	3	1	4
Wyoming	3	1	4			
Wisconsin	1		1	4	2	6
Alaska	2	1	3			
Army and Navy	7		7	35		35
District of Columbia	1		1	1	2	3
Mexico	11	12	23	13	8	21
Canada	1	1	2	1	3	4
Australia	1		1			
Austria				1		1
England				1		1
France				8		8
Ireland				2		2
Norway	1		1			
Spain				1		1
Sweden	1		1	1		1
Unstated	311	143	454	373	141	514
Total	757	347	1,104	861	392	1,253

Death rates from tuberculosis per 100,000 in Arizona in 1919, according to age and sex.[1]

Age groups.	Both sexes.	Male.	Female.
0 to 14 years	39	49	30
15 to 24 years	321	335	308
25 to 34 years	525	572	450
35 to 44 years	643	763	438
45 to 64 years	437	485	344
65 years and over	409	477	303

[1] Rates based on 1910 age distribution of population applied to estimated population of July 1, 1919.

Deaths from tuberculosis in Arizona for 1919, according to length of residence in the State.

Residence in Arizona.	Male.	Female.	Total.	Residence in Arizona.	Male.	Female.	Total.
1-3 months	152	64	216	7-9 years	45	27	72
3-6 months	47	31	78	10 years and over	90	39	129
6-12 months	49	29	78	Unstated	222	81	303
1-3 years	112	52	164				
4-6 years	40	24	64	Total	757	347	1,104

Deaths in Arizona from tuberculosis in 1919, according to race.

White	776	Others	55
Mexican	256		
Indian	17	Total	1,104

Comparison of tuberculosis death rates per 100,000 in Arizona in 1920 with those in registration area, by age and sex.[1]

Age groups.	Both sexes.		Male.		Female.	
	Arizona.	Registration area.	Arizona.	Registration area.	Arizona.	Registration area.
0 to 14 years	35	43	33	42	38	45
15 to 24 years	470	106	471	86	469	125
25 to 34 years	599	160	677	157	475	164
35 to 44 years	624	161	743	182	420	139
45 to 64 years	296	162	366	199	155	126
65 years and over	776	179	985	200	450	149

[1] Rates based on 1910 age distribution of population applied to estimated population of July 1, 1920. The death registration area used includes the 24 States which were in the area in 1915 and has a population of about 65,000,000. The death rates were originally calculated for the age groups 0 to 9, 10 to 19, 20 to 29, etc.; the values for the age groups used above were determined graphic interpretations and these are approximately correct.

Deaths from tuberculosis in Arizona for 1920, according to length of residence in the State.

Residence in Arizona.	Male.	Female.	Total.	Residence in Arizona.	Male.	Female.	Total.
1-3 months	237	86	323	7-9 years	21	10	31
3-6 months	57	31	88	10 years and over	87	45	132
6-12 months	54	28	82	Unstated	242	92	334
1-3 years	123	76	199				
4-6 years	39	25	64	Total	860	393	1,253

Deaths from tuberculosis in Arizona for 1920, according to race.

White	853
Mexican	254
Indian	20
Others	42
Unstated	84
Total	1,253

TYPHOID FEVER.

Forty-four deaths from typhoid fever were reported in 1919, and 33 in 1920. Estimating the mortality rate as 10 per cent, it would seem that 440 cases of typhoid fever occurred in 1919, and 330 cases in 1920. Morbidity returns give 44 cases as having been reported in 1919 and 87 cases in 1920. It is evident that a number of cases of typhoid are not recognized as such, and that physicians are very careless about reporting cases.

DIPHTHERIA.

Deaths due to diphtheria during 1919 were reported as 21; during 1920, 27 were reported. Reports were made of 47 cases in 1919, and 90 cases in 1920.

Most States have some arrangement whereby diphtheria antitoxin is furnished at a reduced price, and free of cost to those unable to pay. Arizona should adopt a similar plan. The antitoxin should be distributed at designated points throughout the State so as to be available in all sections and in remote towns.

INFLUENZA.

There were 189 deaths reported in 1919 from influenza; 129 deaths from the same cause were reported in 1920. Only 3 cases of influenza were reported in 1919, but in 1920 the morbidity returns are much better, 1,736 cases being reported. This improvement in reporting influenza is gratifying and gives an idea of the cooperations physicians can lend when the necessity and importance of reporting a given disease is brought to their notice.

ACCIDENTS.

Deaths from accidents of all cases numbered 246 in 1919; for 1920 the number was 236. Accidents occurring in mines and quarries contributed the largest number of deaths due to any particular occupation or place of employment. There were 47 fatal accidents in mines and quarries in 1919 and 42 in 1920.

Mining is a very extensive industry in Arizona, hundreds of men being employed in the various mining operations. At practically all of the mines, except the very small places, systematic efforts are made to reduce the number of accidents and to instill into the miners the principle of "always be careful." The chief causes of fatal accidents in metal mines (there are no coal mines in Arizona) are as follows:

	Per cent.		Per cent.
Falls of roof	30	Falls of persons	13
Explosives	14	Electricity	4
Haulage	13		

PHYSICAL DEFECTS AND DISEASES REVEALED BY THE SELECTIVE SERVICE DRAFT EXAMINATIONS.

Many important facts relating to the public health were brought to the attention of sanitarians and health officers by the results of the selective-service physical examinations. The predominance of certain diseases, even though some of them are not communicable, and the prevalence of various physical defects in the general population, are as much matters concerning the public health as the sudden appearance of an epidemic disease.

The United States War Department has compiled statistical information showing the physical condition of the men registered and examined in pursuance of the requirements of the selective service act. The statistics cited below relating to the defects and causes of rejection found in men examined from Arizona were obtained from "Defects found in drafted men," issued by the United States War Department.

The average number of rejections for the United States was 463.21 per 1,000. The highest rate for any State was 640.48 per 1,000; the lowest, 354.35 per 1,000. The average for Arizona was 410.01 per 1,000, or the eighth State for the fewest rejections—a very creditable showing.

From Arizona 11,527 men of military age were examined; 1,432 were rejected physically by the local boards; 1,969 were rejected at camp. The total rejections because of physical defects or presence of diseases rendering unfit for military service, 3,401.

Men examined	11,527
Rejected by local boards	1,432
Rejected at camp	1,969
Total rejections	3,401

The most striking fact brought out by the examinations is the high proportion of tuberculosis found among registrants; 717 men, or a ratio of 66.58 per 1,000, were rejected because of tuberculosis. This is the highest ratio per 1,000 for tuberculosis found in any State. A much larger proportion of lung defects was found in the southern part of the State (which includes the city of Tucson) than in the northern section. The rate for venereal diseases is 48.20 per 1,000, as compared with 40 per 1,000 for the United States at large.

The mental deficiency rate appears to be low; in fact, Arizona had fewer rejections for this cause than any other State. Only 25 men, or a ratio of 2.32 per 1,000, were rejected for mental deficiency, as compared with 17.14 per 1,000 for the whole population of the United States.

Valvular diseases of the heart were found in about 23.50 per 1,000, as contrasted with 33 as an average for the other States.

The rate for defective and deficient teeth is low, 3.38 per 1,000. 13.50 per 1,000 is the average for all other States.

Hernia and enlarged inguinal rings are quite common, being 43.64 per 1,000; the average for the United States is 39.92 per 1,000.

Malunion of fractures was found to be relatively higher in the section where the majority of the Indian population resides. The northern, or Indian section, showed a markedly low percentage of foot defects.

WORK OF CHILD WELFARE BUREAU.

The child-welfare bureau of the State board of health is under the direction of a full-time employee. The child-welfare work is directed chiefly along the following lines of activity:

1. Sending out cards, advising parents that a certificate of birth of their child has been filed with the State registrar of vital statistics. This was begun on January 1, 1920.

2. Follow-up work on birth certificates in obtaining supplementary reports of names of children who are reported as unnamed on the certificate of birth.

3. Addresses before various clubs and organizations for the purpose of giving instruction in the care of children as well as stimulating interest in child-welfare work. The appropriation available for defraying traveling expenses to make such addresses is small; hence this field of activity is restricted.

4. Furnishing charts and literature on the care of children for better babies contests, also posters and pamphlets to public-health nurses and school nurses.

5. Acting as supervisor for better babies contests at Arizona State Fair, held at Phoenix each year.

6. Forwarding literature on the care of children to various organizations interested in child hygiene, also to individuals on request.

Several leaflets on the care of the baby have been printed in Spanish for use among the Mexican population. Pamphlets and leaflets in English are also available for distribution.

Previous mention has been made of the fact that apparently the follow-up work of birth certificates is more properly the duty of the bureau of vital statistics. The director of child welfare, although not a nurse, is a mother, and performs efficiently the work mentioned above. It is believed, however, that certain advantages would be gained by employing a director with special training in public-health nursing and child hygiene. This would permit the expansion of the work to include public-health nursing as well. A more liberal appropriation for traveling expenses to be used in carrying forward this work is badly needed.

VENEREAL DISEASE CONTROL.

Venereal disease control work by the Arizona State Board of Health was begun in July, 1919, when a bureau for this purpose was established. The work of the bureau is largely educational, although three clinics are in operation and arsphenamine has been distributed for use in a number of counties.

The bureau has cooperated with the Federal health agencies interested in venereal disease control and has received Federal financial aid for the prosecution of its work.

The educational work consists of the distribution of literature, lectures, and the use of exhibits; and 10,948 pamphlets dealing with the subject of venereal disease control have been distributed since the beginning of this work in the State. The distribution of this literature was accomplished in cooperation with the United States Public Health Service. Ten lectures on venereal disease control were delivered during 1920 in different communities. A poster exhibit is used when the opportunity is afforded at fairs and similar gatherings.

One special venereal disease clinic is maintained in the city of Douglas under the personal supervision of the director. In Phoenix and Tucson free general health clinics are maintained by local welfare organizations. The venereal work at each of the general health clinics is done in cooperation with the bureau of venereal disease control. In addition to the work of these clinics, arrangements have been made with the city health officers of several other towns whereby indigents receive free treatment for venereal diseases.

Arrangements are also effective for the distribution of arsphenamine to those unable to pay for it, and 265 doses of arsphenamine were distributed by the State board of health in 1920.

Provision for free laboratory examinations for the diagnosis of venereal diseases is also in effect. These examinations are made at a private diagnostic laboratory, and the expense is borne by the State board of health. The amount of such laboratory work is quite small. Much wider publicity should be given to the fact that this work is done without cost.

An amendment to the regulations of the State board of health, governing the reporting of communicable diseases, was adopted January 11, 1918, adding venereal diseases to the list of reportable diseases and specifying the method of reporting and controlling such diseases. There has been an encouraging response on the part of physicians in the matter of reporting venereal diseases. Although perhaps only a small percentage of the cases of venereal diseases is being reported, yet the total of cases reported for 1920 is 113 more than were reported in 1919. In 1919 a total of 353 cases of venereal disease was reported; 466 cases were reported in 1920.

The director of the bureau of venereal disease control is also full-time health officer for the city of Douglas. This is a handicap, in that Douglas is 234 miles from Phoenix, the location of the State board of health, and the duties as city health officer necessarily demand the greater portion of his time. More vigorous efforts should be made toward the establishment of other venereal disease clinics, more comprehensive arrangements should be made for laboratory diagnosis of venereal diseases, and attention should be given to the matter of law enforcement with reference to suppression of prostitution.

DIAGNOSTIC LABORATORY.

The State board of health has no diagnostic laboratory. For a short time the laboratory of the Arizona State Insane Hospital performed a certain amount of diagnostic work (chiefly venereal disease specimens) for the State board of health. This plan has been discontinued. As has been previously stated, the venereal disease laboratory diagnostic work is at present being done by a private laboratory in Phoenix. The venereal disease diagnostic specimens are few in number. A total of not more than 12 or 15 specimens has been examined by the private laboratory under the plan above mentioned.

The State board of health has no arrangements with any laboratory for the performance of important public health diagnostic work, such as examinations of cultures from suspected diphtheria cases, or specimens of blood from typhoid fever suspects, or animals thought to be infected with rabies, nor has it a Pasteur institute nor any provision for the free treatment of persons bitten by rabid animals.

One of the most urgent needs of the Arizona State Board of Health is the establishment of a State diagnostic laboratory. A diagnostic laboratory is the means not only of providing an aid in diagnosis to the physicians throughout the State, but it is an invaluable weapon in protecting the public health. Epidemics of diphtheria can be checked if laboratory cultures are made in all suspected or doubtful cases. Without a laboratory confirmation many cases of typhoid fever may go unnoted; consequently, the necessary precautions are not taken to prevent its spread to other members of the household or community. The same thing applies to a number of other diseases.

It is of immeasurable assistance to the physicians of a State in arriving at a correct diagnosis in doubtful, obscure, or ill-defined conditions. From a public health standpoint, a diagnostic laboratory is indispensable for the proper preservation of the health and lives of the inhabitants of any State. A State diagnostic laboratory is of mutual benefit to health officers, physicians, and the public at large.

There is located at Tucson an establishment designated as the State laboratory. This State laboratory occupies quarters in one of the buildings on the campus of the University of Arizona.

The relation of the State laboratory to the State board of health and the University of Arizona is not clearly defined by law, nor is this relation thoroughly understood by the officials themselves. The law provides that the director of the State laboratory shall be selected by the board of regents of the University of Arizona, acting in joint session with the superintendent of public health. The law further requires that the State laboratory be located in rooms set aside for that purpose by the University of Arizona.

The director is required, under the act establishing the State laboratory, to perform all duties prescribed by law and by the board of regents of the University of Arizona, acting in joint session with the superintendent of public health.

It would therefore appear that the director of the State laboratory is responsible jointly to the board of regents of the university and to the superintendent of public health. In practical operation the matter works out on the principle of what is everyone's business is no one's business, and the director is left to work out his own plans as to how the laboratory should be conducted and what work should be done.

The State laboratory and the office of director were established by the act, having for its purpose the protection of food and drink, popularly known as "Arizona pure food law." Therefore, the chief work of the laboratory is the chemical and bacteriological examination of foodstuffs and water supplies. A small amount of diagnostic work is done, practically all of which is for local physicians in Tucson.

The present State laboratory could very easily be converted into a diagnostic laboratory without interfering with the present duties in connection with the food work, and with very small additional expense. The quarters are ample for the addition of the diagnostic work; the director is well qualified as a diagnostic bacteriological and pathological technician. An additional assistant bacteriologist would, of course, be necessary.

The only objection to using the present State laboratory is that Tucson is not the railroad center of the State. It would be rather far removed for specimens from the northern part of the State. As a matter of fact, there is no railroad center for Arizona. Phoenix, although near the geographical center of the State, has only two railroads, neither of which are main lines.

Should the State laboratory be utilized as a diagnostic laboratory, in addition to the food examinations now being performed, the law should be amended so as to place the director and the State laboratory under the immediate supervision of the State board of health.

LOCAL HEALTH AUTHORITIES.

REQUIREMENTS OF LAW.

The law relating to the formation of local boards of health may be summarized as follows:

The county board of health is composed of the chairman of the county board of supervisors, the county attorney, and a superintendent of public health. The county superintendent of public health is appointed by the county board of supervisors for a term of two years. The county board of health is required by law to meet as often as once every three months.

The county boards of health have power in their respective counties, outside of the corporate limits of cities having a city board of health, subject to the supervisory control of the State board of health and the State superintendent of public health.

The powers and duties of a county board of health are as follows:

1. To fix a time and place for the meetings of the board, subject to the provisions of existing law.

2. To make rules and regulations for the government of the board, its officers, and meetings.

3. To make and enforce all needful rules and regulations for the prevention and cure, and to prevent the spread of any contagious, infectious, or malarial diseases among persons and domestic animals.

4. To establish quarantine, and isolate any person affected with any contagious or infectious or epidemic and endemic disease.

5. To isolate, kill, or remove any animal affected with contagious or infectious disease when necessary to protect the public health.

6. To remove, or cause to be removed, any dead, decaying or putrid body, or any decayed, putrid, or other substance that may endanger the health of persons or domestic animals.

7. To condemn or cause to be destroyed any impure or diseased article of food that may be offered for sale.

8. To empower and direct the county superintendent of public health to do, or cause to be done, any and all of the things mentioned in subdivisions 4, 5, 6, and 7.

9. To make such rules and regulations as it may deem necessary to govern the preparation of dead bodies for transportation, and to govern what classes of dead bodies may be transported and the manner thereof.

10. To have charge of the vital statistics registration within the county, and to supervise the uniform and thorough enforcement of this law.

11. To render to the State board of health such reports as are required by law and regulations.

The president and the vice president of the board receive no compensation, but are paid 10 cents for every mile actually and necessarily traveled in the performance of their official duties, and other necessary expenses incurred by them.

The county superintendent of public health, who is required to be a practicing physician within the county, is paid such compensation as the board of supervisors may fix, provided that he shall receive not to exceed $300 per annum, and not to exceed $10 a day when actually and necessarily engaged, and not to exceed 10 cents a mile for each mile actually and necessarily traveled.

The county superintendent of public health is also named by law as county registrar of vital statistics, and for such duties is allowed the sum of $300 per annum.

All expenditures for the county board of health must be authorized by the county board of supervisors before being made. Expenses are certified to by the board of supervisors and are paid as other county bills.

The regulations of the State board of health prescribe the reports that are to be made by the county superintendent of public health to the State superintendent of public health.

Each incorporated city is required to have a city board of health, to be constituted as follows: The mayor appoints two members of the city council, who with the city engineer and the city health officer compose the city board of health. The city health officer is appointed by the mayor and approved by the council, and serves for a term of two years. He is required to be a practicing physician of the city and is paid such salary as the city council may fix. The city health officer is required to give bond in the sum of $1,000 as a guaranty for the faithful performance of his duties.

The powers and duties of a city board of health are similar to those enumerated for the county boards of health. Specific authority is given city health officers to enforce ordinances relating to sanitary matters. It is the custom to appoint the city health officer as local registrar of vital statistics. Both county and city boards of health are known as local boards of health.

According to law only local boards of health can enter court and begin action for violation of health laws. This is a decided disadvantage as it prevents any action by the State board of health in case local authorities refuse, neglect or fail to properly perform their duties.

A justice of the peace within the jurisdiction of a local board of health, upon complaint of such board, may issue a warrant to the sheriff or other peace officer, commanding him to take sufficient aid and, accompanied by at least one member of the local board of health, between the hours of sunrise and sunset, to remove or destroy any nuisance, source of filth or cause of sickness.

Persons violating requirements of the health laws are liable to a fine of not less than $10. or more than $50. or to imprisonment in the county jail not exceeding 30 days, or both. Violations of rules and regulations of local boards of health are defined as misdemeanors and the punishment is stated as a fine not exceeding $100, or by imprisonment in the county jail not exceeding 30 days, or both. Physicians convicted of violations of the health laws and regulations shall have their license to practice revoked.

Local boards of health are authorized to examine into all nuisances, sources of filth and causes of sickness, to abate nuisances, establish temporary hospitals for contagious diseases, investigate contagious diseases, regulate handling and transportation of dead bodies, exclude cases of communicable diseases from attending any public or private school, destroy bedding or clothing exposed to infection from contagious or infectious diseases, and maintain quarantine of contagious or infectious diseases.

The State board of health has superintending control of all local boards of health.

The activities of the local health authorities in several towns of the State are briefly summarized below:

PHOENIX.

Population, 29,053.

The city of Phoenix, although the largest town in the State, has no full-time health officer. The present incumbent is a physician engaged in the active practice of medicine. The personnel of the city health department is as follows:

City health officer (part time), paid by city.
Sanitary inspector (whole time), paid by city.
Milk inspector (half time), paid by city.
Visiting nurse (whole time), paid by local Red Cross.

The duties performed by the city health officer, in addition to directing the work of the other employees, consist of control of communicable diseases, local registrar of vital statistics, and supervision of abatement of nuisances and complaints.

The sanitary inspector, who has the power of a police officer, investigates complaints of nuisances, conducts inspections of restaurants and cafés and placards houses for quarantinable diseases. The city has a pesthouse for isolation of smallpox cases.

The work of the milk inspector consists of the inspection of all dairies selling milk in the city, and the collection of milk samples for examination. Only half time is given to the duties as milk inspector; the remainder of the time is devoted to the duties as city inspector of weights and measures. There is a city ordinance, regulating the sale of milk, but the pasteurization of all milk is not required.

A visiting nurse, paid by the local Red Cross, working under the supervision of the city health department, assists in looking after cases of communicable diseases, gives instruction in child hygiene, and does educational work in matters of hygiene and sanitation.

Through an arrangement with a private pathological laboratory, all specimens of water supplies, nose and throat cultures, milk samples, and blood tests for typhoid fever, are performed without charge to the individual. The city pays a fixed sum for this laboratory work.

The total annual expenditures of the city health department of Phoenix, including the amount paid for laboratory work, are $8,000. Further expansion of the activities and personnel of the city health department is obviously necessary. The most vital need is a city health officer paid a sufficient salary to enable him to give all of his time to the duties of the office.

TUCSON.

Population, 20,292.

The city health officer of Tucson is a practicing physician and devotes only a part of his time to the duties of the office. There is a deputy health officer who acts as sanitary inspector and is vested with the authority of a police officer. The city health officer supervises the reporting and quarantining of communicable diseases, directs the sanitary inspector, and is local registrar of vital statistics.

The chief work of the sanitary inspector consists of investigating complaints, collecting milk samples for examination, inspecting restaurants and soda fountains, and the placarding of houses for presence of communicable diseases.

There is a city ordinance, regulating the sale of milk within the city, and requiring tuberculin testing of all cows whose milk is offered for sale. The sale of milk containing more than 250,000 bacteria per cubic centimeter is unlawful.

Examination of milk samples collected by the inspector of the city board of health is made at the State Laboratory, which is located on the campus of the University of Arizona at Tucson. The city of Tucson expends about $3,500 annually for salaries of the city health officer, sanitary inspector, and incidental expenses.

DOUGLAS.

Population, 9,916.

The only city in the State having a whole-time health officer and maintaining a well organized health department is Douglas. The town is located in close proximity to the international border between the United States and Mexico. One of its main streets runs squarely to the line marking the limits of the United States.

The personnel of the city health department is composed of the following, all of whom are whole-time employees:

	Per annum.
City health officer (additional compensation is received from State board of health for services as director of bureau of venereal disease control)	$3,600
Laboratory technician	3,000
Community nurse	1,800
School nurse	1,800
Sanitary inspector	1.620
Total	11.820

The salary of the school nurse is paid by the school board: the laboratory technician is paid from fees received for laboratory work done for several large industrial plants located in the city. One-half of the salary of the community nurse is paid by the welfare league, a local welfare organization. Therefore, the city of Douglas pays $6,120 of the total of $11,820 expended annually for the city health department, the remaining $5,700 being derived as above mentioned.

The city health officer has direction of the work of the city health department and performs the following duties: Medical inspection of all school children, except high-school students. About 4,000 children are inspected during each school year. Has charge of the detention hospital; smallpox cases, and prostitutes suspected of being infected with venereal disease are cared for at this hospital; conducts free venereal disease clinic; makes inspections of all dairies selling milk in town; inspections of water supplies; performs smallpox vaccinations without charge; local registrar of vital statistics. The city health officer has also secured the cooperation of local surgeons in conducting a free surgical clinic for school children needing surgical attention but who are unable to pay for such treatment.

The laboratory of the city board of health is adequately equipped and well conducted. All ordinary laboratory work, except examination of tissue specimens, is done. All work for the city is done free; this includes indigents of the city. The county pays for work done for those living out of the town, who are unable to pay. Fees are charged for private work. The greater part of the private work comes from the hospitals maintained in Douglas by several large industrial companies (smelters). The salary of the technician and the maintenance expenses of the laboratory are paid by the fees from private work.

Tabulation of specimens examined at Douglas City laboratory during 1920.

Blood counts	224	Spinal fluid	1
Blood typing	9	Throat cultures	41
Blood coagulation time	1	Tissue (sent to El Paso, Tex.)	24
Dairy milk	144	Vaccines	27
Guinea pig inoculations	5	Urine	548
Feces	16	Wassermann reaction	722
Gastric analyses	13	Widal reaction	10
Pneumonia typing	3	Water examinations	20
Mothers' milk	12		
Smears	142	Total number specimens	1,962

Under the present arrangements the laboratory could not be maintained without the fees from private work. There is no objection to a laboratory doing private work, provided the original purpose of protecting the public health is always kept clearly in view. A laboratory that is supported by fees from private work quite naturally will give preference to such work. The city laboratory of Douglas could be made of a great deal more service to the inhabitants of the vicinity by performing all laboratory examinations without charge, for persons residing in the town. Fees could be accepted for work done for the industrial hospitals.

The community nurse acts as a visiting nurse, assists in caring for indigent sick, gives instruction in child hygiene, distributes educational literature, and aids the city health officer in any additional work as required. This nurse also keeps a check on the placarding of communicable diseases and observance of quarantine.

The duties of the school nurse consist of helping in medical inspections of school children, looking after follow-up treatment in children found to have defects requiring attention, and making inspections regarding sanitary conditions in school buildings. Instruction in hygiene is also given by this nurse.

The sanitary inspector has supervision of the collection of the city garbage; he also placards houses for communicable diseases, does fumigation work when required, and collects specimens of milk for examination. The sanitary inspector, in addition to the above-enumerated duties, has charge of the city detention hospital. He also investigates complaints of nuisances.

Among the ordinances enforced by the city health officer is one requiring the tuberculin test on all dairy cows before issuing a permit to sell milk.

BISBEE.

(Population, 9,205.)

The city health officer of Bisbee is a part-time official. He performs the sanitary inspection work, quarantine duties, and acts as local registrar of vital statistics. In addition to the city health officer, Bisbee has a bacteriologist and city school physician. The physician, who is bacteriologist and school physician for Bisbee, is also county superintendent of public health, and devotes all of his time to the duties just mentioned, including duties as registrar of vital statistics.

This county superintendent of public health does not engage in private practice but devotes all of his time to public-health duties. Most of his time is taken up as bacteriologist and school physician for the city of Bisbee; the remainder is given to the county-health work.

The county health work will be first considered. All laboratory work for the county having a bearing on public health is done free of cost. This includes examinations of water supplies, milk samples, throat cultures, and blood in typhoid suspects. A rural-school nurse visits all the schools in the county, except those of the two largest towns, Bisbee and Douglas, for the purpose of inspecting children for detection of the more apparent physical defects. This nurse is provided with an automobile to enable her to visit all the rural schools. Inspection of school buildings and grounds, as well as valuable educational work in hygiene, is done by the rural-school nurse. During the last three months in 1920 the rural-school nurse inspected 912 children. The nurse is paid by the county school board.

The control of communicable diseases in the county and the duties of county registrar of vital statistics are also done as county health work.

As previously suggested, the greater amount of the work done is as city bacteriologist and city school physician rather than the county health work. The work of city bacteriologist consists of the usual routine laboratory examinations. All of the laboratory work is done free of charge.

Tabulation of specimens examined by public health laboratory of Bisbee, 1920.

Dairy milk	461	Sputum for tuberculosis	46
Cultures for diphtheria	14	Water examinations	94
Miscellaneous	57		
Blood for typhoid	11	Total specimens examined	683

The laboratory, although small, is well equipped and efficiently conducted. The work of the laboratory should be expanded and an assistant bacteriologist employed.

The duties performed as city school physician for Bisbee include inspection of school buildings and grounds, physical examination of teachers, medical inspection of pupils once annually, correction of physical defects, educational work in health matters, supervision of physical education and supervision of students engaged in athletics. A total of 4,851 school children was examined during 1920.

Assisting in the school work are school nurse, visiting nurse, and office clerk. The school nurse assists the school physician in making inspections of buildings and grounds, conducting physical examinations of school children and in administering the necessary treatment suggested for minor defects.

The visiting nurse does follow-up work in the homes and gives class instruction in hygiene to the school children. The office clerk performs all clerical work, including clerical work of the laboratory.

A dentist is usually employed by the school board to give part of his time to school inspection for a limited period each year.

Personnel.—County superintendent of public health, paid by county; city school physician for Bisbee, paid by school board; city bacteriologist for Bisbee, paid by city. (These are one individual—whole time.)

School nurse (whole time), paid by school board.

Visiting nurse (whole time), paid by local Red Cross.

Office clerk (whole time), paid by local Red Cross.
Rural school nurse (whole time), paid by county school board.
Dentist (part time), paid by school board.

The above described organization is rendering efficient service, but for the purpose of uniformity in administration, it appears desirable to combine the duties of city health officer with those of city bacteriologist and city school physician, and separate those entirely from the office of county superintendent of public health.

Matters of political expediency should have no bearing upon the effectiveness of public health administration.

There are, in addition to the activities of the local boards of health above described, about 30 public health nurses in different towns of the State. Sixteen of these are employed by local school boards, 4 by local chapters of the American Red Cross, 3 by county antituberculosis associations, 1 by associated charities, 1 by welfare league, 1 by city council, and the remaining 4 by two or more of these agencies working jointly. These nurses, scattered in 30 towns and mining camps of the State, are carrying forward a very important work. Some of them are working in cooperation with the existing health authorities, many of them are not. There is urgent need for a public health nurse, representing the State board of health, to coordinate and cooperate with these public health nurses.

DISCUSSION.

A State health department, in order to do effective work, must be equipped to send trained experts to any part of the State at any time. Local health officers frequently need assistance and advice. The State health department is the logical place from which such aid should come. The epidemiological activities of any health department form a very important part of the work. The State health organization of Arizona should not only have a full time executive head, but whole time employees, trained in epidemiology, bacteriology, and sanitary engineering.

A mobile trained sanitary personnel is particularly needed by the State health department of Arizona because of the close proximity to Mexico, the constant shifting back and forth of a large Mexican population, and the ever present danger of introduction of some epidemic. Smallpox and typhus fever are prevalent in Mexico the year round. Bubonic plague also has been reported in certain seaports and one interior town in Mexico.

The United States Public Health Service maintains an inspection of all persons entering the United States from Mexico at the three legal ports of entry in Arizona, Douglas, Nogales, and Naco.

The international border between Arizona and Mexico, as stated in the beginning of this study, is 335 miles long. There is very little hindrance to crossing the border at any place other than the three ports of entry above mentioned. Thus it can be readily understood how many Mexicans from the interior may cross the border into Arizona without being inspected or examined. Obviously, it is impossible to patrol the entire 335 miles of border.

From the standpoint of the State of Arizona, the best solution of the problem is to encourage the early reporting by any person, as well as physicians, of all suspected cases of communicable diseases, with special emphasis on smallpox and typhus fever. By having trained sanitarians available at all times, the State health department would be prepared to cope with any situation that might arise.

The work of the Arizona State Health Department should be conducted under four divisions—epidemiology, sanitary engineering, vital statistics, and laboratory. No epidemiological work of any consequence is now being done.

The State laboratory is of little service, save for the examination of foodstuffs and water supplies. This laboratory should be made an integral part of the State health department and its scope enlarged to include the examinations of specimens for typhoid fever, paratyphoid fever, tuberculosis, intestinal parasites, syphilis, gonorrhoea, malaria, and the bacteriological examination of milk and water. The proper city for the location of the laboratory is difficult to determine. It would doubtless be best to use the present State laboratory as the main laboratory and establish a small branch laboratory in conjunction with some county board of health in the northern part of the State to take care of the work from that section.

Practically no supervision is now exercised by the State board of health over the production, distribution, and handling of milk that is offered for sale. This important public health duty is delegated by law to the office of the State dairy commissioner. In no sense is the suggestion made that the State board of health take over all the duties of the State dairy commissioner. The work of fostering, encouraging, advising, and building up the dairy industry is entirely the work of the State dairy commissioner. But it does seem desirable to suggest that the sanitary supervision of dairies, producing milk to be offered for sale, be placed under the State board of health. Milk is the universal food, and its care and protection is distinctly a problem for the health authorities. An official who is trying to foster the dairy industry and keep the good will of all dairymen can not at the same time require a sufficiently high sanitary standard to properly safeguard the interests of the public health.

Proper inspection of milk in Arizona is doubly important because of the presence of a large number of active human cases of tuberculosis and because there is no State law or regulation requiring dairy cattle to be tuberculin tested.

For these reasons it is deemed wise to recommend that the State board of health be given supervision of the production, distribution, handling and storing of all milk offered for sale.

PUBLIC HEALTH ENGINEERING.

REQUIREMENTS OF LAW.

Obstruction of the free passage or use, in the customary manner, of any navigable lake or river, bay, stream, canal, or basin is declared to be a nuisance. The placing of any dead animal, or the offal from any slaughter pen, corral, or butcher shop into any river, creek, pond, reservoir, or stream is forbidden. It is a misdemeanor to place a water-closet, privy, carcass of any dead animal, or any offal of any kind in or upon the borders of any stream, pond, lake, or reservoir that is used as a public water supply, or to foul or pollute such water supplies in any other manner. Water-closets, privies, and cesspools are required to be kept in good condition.

The only supervision of the public water supplies throughout the State is that exercised by the director of the State laboratory in collecting samples for examination. There is no sanitary engineer attached to the State board of health and no attempt is made to perform the public health engineering work that should be done by a State health department.

The supervision of sewage and garbage disposal, water supplies, industrial wastes and studies of the housing problem in mining camps, in its relation to the public health, are among the duties that should devolve upon a sanitary engineer employed by the Arizona State Board of Health.

The existing law places investigations of public water supplies under the director of the State laboratory, an official over whom the superintendent of public health has practically no control. Such a plan is not satisfactory. The results of bacteriological examinations of water must be studied and interpreted by experts in connection with field investigations of the sources of the water. Any other procedure is worse than valueless. Any person may look at an X-ray plate and draw conclusions from it, but only the deductions drawn by one skilled in X-ray work are reliable or of any value. So it is with interpretation of water examinations.

The presence in the State of a large number of mining camps and industrial plants is an added reason for the necessity of a sanitary engineer for the State board of health.

INSPECTION OF FOOD AND DRINK.

The law relating to the manufacture, sale, or transportation of adulterated, mislabeled, or misbranded foods or liquors is similar to the United States Statutes on this subject. The standard of purity of food and liquor is expressly stated by law to be that proclaimed by the authorities administering the United States pure food and drug act.

The superintendent of public health is responsible for the enforcement of this law, to the extent that he shall cause examination and analysis of food to be made by the director of the State laboratory, and report violations to the county attorney. The actual enforcement of the law is left to the county attorney and sheriff in the county where the violation occurs. The superintendent of public health should be authorized to enter prosecutions for violations of this law or any other health law and not have to depend upon local county attorneys or local health authorities to begin legal action.

INSPECTORS.

There are no provisions or appropriations for inspectors to collect samples of food or drink for examination in the enforcement of the law. Neither are there inspectors for investigating violations of the law. The director of the State laboratory is obliged to go out and collect samples personally, investigate such violations as may seem apparent, and then return to the laboratory and perform the examinations of the samples secured. The appropriation available for traveling expenses is quite small, hence the work necessarily is limited. At least two food inspectors with adequate traveling allowances are needed for the reasonable enforcement of the "Pure food law."

The present "Pure food law" would be rendered more efficient by the addition of a seizure provision by which suspicious foodstuffs could be held, pending further investigation or court proceedings. An amendment is also needed, permitting inspections of all places handling or storing food products offered for sale, and authorizing the issuing of regulations governing the handling, care and storing of food products.

The personnel of the State laboratory with their annual salaries is as follows:

PERSONNEL OF STATE LABORATORY.

Director (full time), $1,800 per annum.
Bacteriologist (full time), $1,500 per annum.
Clerical assistant (part time), $300 per annum.

The laboratory is located on the campus of the University of Arizona in rooms set aside according to law for that purpose. This arrangement saves the payment of rental for quarters, and also provides electric, gas, and janitor service. The total annual appropriation for the maintenance of the State laboratory is $4,500. This appropriation is entirely separate and distinct from the appropriation of the State board of health. The State board of health has nothing to do with the expending of the appropriation for the State laboratory.

The salaries paid the director and bacteriologist are entirely too small for the responsibility involved and the work done.

Tabulation of expenditures of State laboratory for 1920.

Salaries	$3,046.86	Scientific books and journals	$44.97
Railroad fare	152.15	Express and freight	83.32
Stage fare	65.10	Laboratory supplies and equipment	268.02
Traveling expenses	383.93	Chemical supplies	50.08
Samples	33.33	Office supplies	42.07
General expenses	87.19		
Telephone	87.40	Total expenditures	4,422.62
Telegraph	30.55	Total appropriation	4,500.00
Ice	47.65		

Arrangements have recently been made whereby the State laboratory receives $25 monthly for examinations of milk made for the State dairy commissioner. This is applied to the payment of the salary of the bacteriologist.

ANNUAL REPORT OF EXAMINATIONS MADE BY ARIZONA STATE LABORATORY DURING 1920.

Character of examination or specimen.

	Specimens examined.
Laboratory investigations of water supplies:	
(*a*) Public water supplies	253
(*b*) Private water supplies	51
(*c*) Railroad water supplies	15
Field investigations and sanitary surveys of water supplies	15
Pure food inspections of grocery stores	127
Examinations for laboratory diagnosis	122
Bacteriological examinations of milk	214
Ice creams examined for butter fat	48
Analysis of suspected foods	64
Samples collected for United States food and drug inspection	15
Drug stores inspected for United States food and drug inspection	27
Total	951

The analysis of food and drink samples should be made under the direction of the official who is responsible for the enforcement of the "pure food law." That is, the superintendent of public health, who is responsible for the administration of the law, should have control of the laboratory where the analyses are done.

As has been repeatedly pointed out, the State laboratory should be expanded into a diagnostic laboratory and placed under the charge of the State board of health.

PUBLIC HEALTH EDUCATION.

The State board of health publishes quarterly a bulletin which is distributed throughout the State. The bulletin contains tabulations of vital statistics of the State, also articles dealing with health matters.

Several small leaflets, dealing particularly with the care of children, venereal disease control, prevention of tuberculosis, and the care of tuberculous persons have been issued. Two or three leaflets have also been printed in Spanish.

A few addresses are made from time to time during the year in various parts of the State by the director of the child welfare bureau and the director of the venereal disease control bureau. The State board of health owns two panel exhibits on public health subjects. These are used chiefly at fairs.

It is believed to be desirable for the State board of health to issue bulletins of a popular educational nature, dealing with the particular sanitary problems found in Arizona. When vital statistics are included in bulletins, some effort should be made to interpret their meaning so that the public may understand the lessons derived from and value of collecting such statistics. There is nothing so dry or uninteresting to the average person as vital statistics unaccompanied by an intelligent explanation.

The State board of health needs more publicity as to what it is doing and can do for the inhabitants of the State. Addresses on public health subjects should be given by a representative of the State board of health whenever an opportunity presents itself.

An effort should be made to place before the public as clearly as possible the difference between public health work and medical relief, or charity work. Much confusion over this rather difficult and widely misunderstood subject has already arisen.

HEALTH SUPERVISION OF SCHOOLS.

The law provides for the exclusion of children from school who have any dangerous, infectious, or contagious disease. Regulations of the State board of health also provide for the exclusion of children from school who are actually infected with certain communicable diseases not expressly mentioned in the law.

Other than the above the State board of health or local boards of health have no authority for health supervision of the schools. Most of the medical inspection work that is done in the schools is conducted under the authority of the local school boards. The law requiring compulsory vaccination before being allowed to attend any school was repealed after much agitation by the numerous anti-medical cults.

The State board of health has issued a set of regulations regarding the proper construction of school buildings, as relating to heating, lighting, ventilation, toilet facilities, and water supplies.

About 16 county and city school boards employ school nurses for health supervision of school children.

The rural population of Arizona is scattered over a large area. Medical supervision of schools for the remote districts is difficult, because the schools are so widely separated. An amendment to the existing law permitting one or more towns or a county and one or more towns to combine their funds and employ a full-time health officer, would allow the formation of an adequate health organization in any county or towns desiring to do so. Proper health supervision of the schools would come as a natural consequence in the extension of public-health activities.

APPROPRIATIONS AND EXPENSES.

The appropriations of the various departments of the State of Arizona are made for a two-year period. The fiscal year of the State is from July 1 to June 30. The appended tabulation shows the available amounts for the State Board of Health, as specified in the appropriations bill. The total yearly amount appropriated by the State that may be expended is $19,700. This does not include $1,774 that is set aside annually from the general fund of the State for traveling expenses for the superintendent of public health only, or the amount that is received as Federal aid for venereal-disease control.

For the fiscal year ending June 30, 1920, the amount of revenue received by the State was as follows: Taxes, $5,596,390.68; other sources, $2,631,055.70; total, $8,227,446.38. The total yearly expenditures of the State were $6,847,090.37. The value of the taxable property in the State was $884,443,183. Estimating that adequate protection of the public health of a State requires an expenditure of 2 per cent of the State revenues, the State of Arizona should expend $175,000 annually for public health activities.

Tabulation of appropriations and disbursements of the State board of health for fiscal year ending June 30, 1920.

Appropriation.		Disbursements.	
Purpose.	Amount.	Purpose.	Amount.
Salary, superintendent of public health and State registrar.	$2,000.00	Salary	$2,000.00
		Traveling expenses ($625.80) for year not paid from funds of State board of health, but from general State fund.	
Office expenses	2,000.00	Traveling expenses	625.80
		Stationery and supplies	265.06
		Postage	163.02
		Telephone and telegraph	100.43
		Freight and drayage	14.40
		Printing	1,367.50
		Medical supplies	27.20
		Binding reports	32.80
		Miscellaneous	28.20
			2,624.06

Tabulation of appropriations and disbursements of the State board of health for fiscal year ending June 30, 1920—Continued.

Appropriation.		Disbursements.	
Purpose.	Amount.	Purpose.	Amount,
Clerical fund	$3,000.00	Salaries of clerical assistants	$2,331.85
			4,955.93
Rural sanitation	2,250.00	Salary, director surveys and inspection	1,154.82
		Traveling expenses	354.36
		Printing	211.60
		Miscellaneous	10.00
			1,730.78
Tuberculosis and child welfare	5,000.00	Salary, director of child welfare	652.33
		Salary, executive secretary	1,230.24
		Clerical assistance	415.30
		Tuberculosis nurse	1,257.60
		Clerical work	90.18
		Travelling expenses	408.38
		Printing	862.35
		Miscellaneous	14.95
			4,931.23
Venereal-disease control	2,250.00	Salary, director	1,500.00
Federal aid	1,583.59	Clerical assistance	399.96
		Extra help	100.00
		Traveling expenses	460.61
		Telephone and telegraph	8.25
		Printing	177.42
		Medical supplies	356.94
		Lectures	276.37
Total amount available	3,833.59		3,279.45
Bulletin and publicity work	2,200.00	Salary, executive secretary	408.45
		Stationery and supplies	326.99
		Postage	304.49
		Printing	691.00
Public-health lectures and educational work.	1,000.00		1,730.93
		Salary, executive secretary	421.87
		Clerical assistance	15.40
		Printing	235.84
		Educational films	225.00
		Miscellaneous	6.00
Total appropriation [1]	19,700.00		904.11
		Total disbursements [2]	16,532.43

---

[1] $1,583.59 Federal aid for venereal-disease control not included.

[2] $626.80 expended from general fund of the State for travelling expenses of superintendent of public health not included.

By including the $1,583.59 received as Federal aid in venereal disease control, the total amount available is $21,283.59. Deducting the total expenditures of $19,532.43, an unexpended balance of $2,751.16 remains for the fiscal year. Five hundred and fifty-four dollars and fourteen cents of this balance belong to the venereal-disease fund.

RECOMMENDATIONS.

In view of the urgent need of a reorganization and coordination of the public-health activities of the State of Arizona, and further, considering the necessity for economy of administration, the following definite recommendations for improved sanitary organization are herewith submitted:

1. That the present designation of the State board of health be changed to the State health department.

2. That the State health department consist of a State health commissioner and a State board of health.

3. That the State health commissioner be a full-time officer, selected solely on merit, and appointed by the State board of health, at an annual salary of not less than $4,000 per annum; that he be a physician, skilled in sanitary science and experienced in public-health administration, and that he not be required to reside in the State prior to appointment; that he be prohibited from engaging in anything but official business; that he be authorized and charged with the administration of the laws and regulations issued thereunder by the department, and the preparation of regulations for the consideration of the State board of health, and, with the approval of the board, the appointment and removal of subordinates in the department.

4. That the State board of health consist of the State health commissioner, ex officio, and three members, at least one of whom shall be a physician; all to be public-spirited citizens, and appointed by the governor in such manner that the term of one shall expire every two years; that the State health department be empowered to promulgate regulations, to consider public-health plans, appeals and appointments, and to submit biennially to the legislative assembly, through the governor, a report of the recommendations as to needed legislation.

5. That the State board of health meet at least once annually, and on the call of the State health commissioner, or on request of a majority of the members, to consider and advise in public-health matters, and that its members receive necessary traveling expenses incurred while attending such conferences.

6. That the State health commissioner be required by the State board of health to attend conferences of State and Territorial health officers, convened by the Surgeon General of the United States Public Health Service under the act of Congress of July 1, 1902.

7. That the regulations not inconsistent with Federal or State laws promulgated by the State board of health be given the force and effect of law and be made the minimum requirements of localities throughout the State. That the State health commissioner be empowered to enforce such regulations to prevent disease and protect the public health in any locality where the local authorities neglect, fail, or refuse to do so.

8. That an epidemiologist be appointed by the State health commissioner, with the approval of the State board of health, at a salary of not less than $3,000 per annum, who shall be charged with the

epidemiological work of the State health department, such work to include the control of communicable diseases, industrial diseases, supervision of rural sanitation, dental hygiene, school inspection, and the control of venereal disease.

9. That a sanitary engineer be appointed by the State health commissioner, with the approval of the State board of health, at a salary of not less than $3,000 per annum, each engineer to make inspections and investigations relating to the purity of water and milk supplies, the disposal of sewage, garbage and other wastes, including industrial wastes, and to aid in the handling of sanitary-engineering matters. affecting the prevention of disease in towns and counties of the State.

10. That the director of the State diagnostic laboratory be appointed by the State health commissioner, with the approval of the State board of health, at a salary of not less than $2,500 per annum.

11. That a bacteriologist be appointed by the State health commissioner, with the approval of the State board of health, upon the recommendation of the director of the State diagnostic laboratory, at a salary of not less than $2,000 per annum.

12. That a public health nurse be appointed by the State health commissioner, with the approval of the State board of health, at a salary of not less than $2,400 per annum, to supervise, under the direction of the State health commissioner, child-welfare work throughout the State, and nursing, in relation to prevention of diseases.

13. That two inspectors be appointed by the State health commissioner, with the approval of the State board of health, at a salary of not less than $1,800 per annum, each, to make inspections, obtain samples for examination, and assist in the enforcement, under the direction of the State health commissioner, of the "pure food act," and such other sanitary regulations as may be promulgated by the State board of health.

14. That the State health department be authorized to exercise sanitary supervision over the production, handling, storing, and distributing of all milk that is offered for sale, and that authority to promulgate and enforce regulations for this purpose be given by law.

15. That all employees of the State health department be full-time and hold their office during efficiency.

16. That the present State laboratory, located at Tucson, be expanded into a State hygienic laboratory and be made an integral part of the State health department under the supervision and direction of the State health commissioner.

17. That the State hygienic laboratory be equipped and required to perform bacteriological examinations of water and milk supplies, sewage and waste disposal, cultures of disease-producing organisms,

and other public health specimens; that all chemical and bacteriological examinations of food and drinks, deemed necessary by the State health department in the enforcement of the "pure food act," be made in the State diagnostic laboratory at Tucson.

18. That the work of the State hygienic laboratory be expanded in amount and scope so that the physicians and public health officers in the State may have greater facilities to assist them in the diagnosis and control of communicable diseases.

19. That the collection and compilation of vital statistics, now performed in accordance with the law, be done by a chief statistician, under the supervision and direction of the State health commissioner.

20. That the model law for morbidity reports, adopted by the State and Territorial health officers, in conference with the United States Public Health Service, be changed to meet local requirements, and put into effect by regulations of the State health department.

21. That the State health department be authorized to remove from office, after due warning, any health officer or local registrar of vital statistics who fails, neglects, or refuses to perform the duties of his office in a manner satisfactory to the State health commissioner.

22. That energetic efforts be made to secure the notification of reportable diseases and complete registration of births and deaths.

23. That county registrars be required to appoint a sufficient number of local registrars, including local registrars for the rural areas surrounding incorporated towns and cities, and that statistics recorded by local city registrars include only the births and deaths occurring within that city or town.

24. That the State health department and local health authorities be charged specifically with the enforcement of existing State laws as affecting their jurisdictions.

25. That provision be made by which two or more counties, or towns and counties may combine in the employment of a full-time health officer.

26. That more adequate quarters for the State health department be provided in the State house at Phoenix.

27. That educational bulletins and leaflets of a popular nature on public health matters be published and otherwise secured for wide distribution throughout the State.

28. That all accounts with local and county registrars be kept and settled according to the present State fiscal year.

29. That more comprehensive regulations be promulgated by the State health department for the purpose of controlling the preventable diseases.

30. That every effort be made to procure adequate health departments in all counties, towns and cities.

31. That it be made compulsory by law for all persons, firms, corporations, towns or cities to secure from the State health department approval for any proposed installations, improvements, or changes of water supplies, sewage and refuse disposal systems.

32. That the State health department be empowered by law to prevent the use of water from any well, spring, or other source that in its opinion is dangerous to health.

33. That an epidemic fund be set aside for use, with the approval of the governor, in cases of epidemics, or other emergencies, affecting the public health.

34. That an annual appropriation of not less than $45,550 be made by the State to support the activities of the State health department, this amount to be expended about as follows:

1. State health commissioner	$4,000
2. Travel allowance for commissioner	900
3. Travel allowance for members of the State board of health	300
4. Epidemiologist	3,000
5. Travel allowance for epidemiologist	900
6. Sanitary engineer	3,000
7. Travel allowance for sanitary engineer	900
8. Bacteriologist (director of State laboratory)	2,500
9. Travel allowance, director of State laboratory	300
10. Assistant bacteriologist and chemist	2,000
11. Public health nurse (child welfare)	2,400
12. Travel allowance for public health nurse	900
13. Two milk and food inspectors ($1,800 a year each)	3,600
14. Travel allowance for milk and food inspectors	2,400
15. Chief clerk	1,800
16. Chief statistician	1,800
17. Stenographer and clerk	1,500
18. Stenographer, State laboratory	1,200
19. Clerk	1,200
20. Janitor, State laboratory	900
21. Additonal laboratory equipment	350
22. Laboratory supplies	300
23. Freight and express	500
24. Postage	500
25. Printing, stationery, and office supplies	2,500
26. Biological products	500
27. Miscellaneous	400
28. Funds for cooperative work with Federal and other health agencies, including tuberculosis, and venereal-disease control	5,000
Total	45,550

ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
10 CENTS PER COPY
▽

TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 123
DECEMBER, 1921

TRANSACTIONS OF THE SECOND ANNUAL CONFERENCE OF STATE SANITARY ENGINEERS

LIBRARY OF THE HARVARD MEDICAL SCHOOL

HELD AT BOSTON, MASS.
JUNE 1, 2, 1921

PREPARED BY DIRECTION OF THE SURGEON GENERAL

WASHINGTON
GOVERNMENT PRINTING OFFICE
1922

TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 123
DECEMBER, 1921

TRANSACTIONS OF THE SECOND ANNUAL CONFERENCE OF STATE SANITARY ENGINEERS

HELD AT BOSTON, MASS.
JUNE 1, 2, 1921

PREPARED BY DIRECTION OF THE SURGEON GENERAL

WASHINGTON
GOVERNMENT PRINTING OFFICE
1922

LIBRARY OF THE * HARVARD MEDICAL SCHOOL *

A 32 B. 1881.3, no 123

TABLE OF CONTENTS.

Page.

Standing committees ---- IV

Provisional program ---- V

Morning session, June 1, 1921 ---- 1

- Representatives present ---- 2
- Report of corresponding secretary ---- 3
- Some productive activities of a State engineering office, Robert B. Morse ---- 5
- The typhoid epidemic at Salem, Ohio, W. H. Dittoe ---- 11

Afternoon session, June 1, 1921 ---- 28

- Report of committee on water supplies ---- 28
- State sanitation, Prof. George C. Whipple ---- 33
- Report of committee on cross connections, by-passes, and emergency intakes on public water supplies ---- 47
- Epidemics from steamboat water supplies, J. I. Connolly ---- 56
- The policy concerning certification of interstate carrier waters, I. W. Mendelsohn ---- 65
- Cooperation of State health departments in the certification of interstate water supplies, Ellis S. Tisdale ---- 70

Morning session, June 2, 1921 ---- 76

- Report of conditions under which drinking water is being supplied on vessels operating in interstate traffic on the Great Lakes, with reference to typhoid fever among Great Lakes seamen, A. E. Gorman ---- 77
- Report of committee on certification of interstate carrier waters ---- 95

Afternoon session, June 2, 1921 ---- 95

- Report of committee on milk supplies ---- 96
- The supervision of milk pasteurization in Minnesota, H. A. Whittaker ---- 99
- State control of stream pollution and sewage disposal in Connecticut, J. Frederick Jackson ---- 103
- Report of committee on sewage disposal and stream pollution ---- 110
- Report of committee on mosquito control ---- 113
- Report of committee on swimming pools ---- 124
- Report of committee on constitution ---- 127

ILLUSTRATIONS.

Page.

FIG. 1. Chronological chart of typhoid fever epidemic at Salem, Ohio ---- 13

2. Results of bacteriological investigations, Salem public water supply, October 18, 1920 ---- 14

3. General plan of Green Street and vicinity, showing location of waterworks, gravity line, and sewers ---- 17

4. Plan of reservoirs ---- 20

5. Location of gravity water line and sewers on Green Street ---- 23

6. Typhoid fever cases hospitalized at United States marine hospitals in Great Lakes district ---- 87

7. Typhoid fever cases hospitalized at United States marine hospitals ---- 90

STANDING COMMITTEES.

WATER SUPPLY.

W. H. Dittoe, *Chairman.*

C. A. Emerson, Jr.
Ralph Hilscher.
A. H. Jewell.
Robert B. Morse.

SEWAGE DISPOSAL AND STREAM POLLUTION.

E. H. Ehlers, *Chairman.*

H. F. Ferguson.
G. H. Hazlehurst.
H. E. Miller.
E. S. Tisdale.

MILK SUPPLY.

C. A. Emerson, Jr., *Chairman.*

C. M. Baker.
J. C. Diggs.
H. Gray.
E. D. Rich.

LAWS, ORGANIZATION, POLICY, AND PROCEDURE.

H. A. Whittaker, *Chairman.*

E. L. Filby.
J. H. O'Neill.
E. D. Rich.

MOSQUITO CONTROL.

R. Messer, *Chairman.*

H. P. Croft.
C. N. Harrub.
F. W. Simons, Jr.
H. C. Woodfall.

SWIMMING POOLS.

Stephen de M. Gage, *Chairman.*

Ralph Hilscher.
G. W. Simons, Jr.

PROVISIONAL PROGRAM.

WEDNESDAY, JUNE 1.

MORNING SESSION, 10 A. M.

Roll call of States.

Report of executive committee—H. A. Whittaker, chairman; S. Pincus, C. A. Emerson, jr., G. W. Simons, jr., M. Z. Bair.

Report of secretary—M. Z. Bair.

Report of corresponding secretary—I. W. Mendelsohn.

"Some productive activities of a State sanitary engineering office—Robert B. Morse, chief engineer, Maryland State Board of Health.

Report of committee on water supply—W. H. Dittoe, chairman.

AFTERNOON SESSION, 2 P. M.

Address: "State sanitation"—George C. Whipple, professor of sanitary engineering, Harvard University.

Report of committee on cross connections and by-passes on water supplies—S. Pincus, chairman.

The certification and supervision of water supplies on interstate carriers:

- "Water-borne epidemics among passengers and crews of vessels"—J. I. Connolly, assistant sanitary engineer, United States Public Health Service.
- "The policy of the Public Health Service for the supervision of water supplies of common carriers"—I. W. Mendelsohn, assistant sanitary engineer, United States Public Health Service.
- "Experiences with the supervision of water supplies on vessels plying on the Great Lakes"—A. E. Gorman, assistant sanitary engineer, United States Public Health Service.
- "The cooperation of the State health departments in the certification of interstate water supplies"—E. S. Tisdale, sanitary engineer, West Virginia State Board of Health.

Report of committee on laws, organization, policy, and procedure—H. A. Whittaker, chairman.

THURSDAY, JUNE 2.

MORNING SESSION, 9 A. M.

Report of committee on milk supply—C. A. Emerson, jr., chairman.

"Supervision of milk pasteurization in Minnesota"—H. A. Whittaker, director, division of sanitation, Minnesota State Board of Health.

Report of committee on stream pollution and sewage disposal—E. H. Ehlers, chairman.

"State control of stream pollution and sewage disposal in Connecticut"—J. F. Jackson, director, bureau of engineering, Connecticut State Department of Health.

Report of committee on mosquito control—R. Messer, chairman.

"Mosquito control work in Arkansas"—M. Z. Bair, sanitary engineer, Arkansas State Board of Health.

AFTERNOON SESSION.

Report of committee on swimming pools—Stephen DeM. Gage, chairman.

"Ratproofing from an engineer's point of view"—A. F. Allen, associate sanitary engineer, United States Public Health Service.

Election of officers.

SECOND ANNUAL CONFERENCE OF STATE SANITARY ENGINEERS.

TRANSACTIONS.

Morning Session, Wednesday, June 1, 1921.

The Second Annual Conference of State Sanitary Engineers was called to order at 10 o'clock a. m., June 1, 1921, at the State House, Boston, Mass., Mr. Whittaker presiding.

The following persons were present during the conference:

Representatives of the State health departments:

Connecticut -----Mr. J. Frederick Jackson, director, sanitary engineering.
Georgia---------Mr. H. C. Woodfall, director, division of sanitary engineering.
Indiana---------Mr. John C. Diggs, State sanitary engineer, water and sewage laboratory.
Kansas ---------Prof. Albert Jewell, chief, division of water and sewage.
Massachusetts ---Mr. Wright, sanitary engineer.
Michigan--------Mr. E. D. Rich, State sanitary engineer.
Minnesota-------Mr. H. A. Whittaker, director, division of sanitation.
Mississippi------Mr. H. A. Kroeze, State sanitary engineer.
Missouri --------Mr. Joel I. Connolly, State sanitary engineer.
New Hampshire--Mr. Charles D. Howard, chemist in charge of water supplies.
New Jersey -----Mr. H. P. Croft, chief, bureau of engineering.
New York-------Mr. Theodore Horton, director, division of sanitary engineering.
North Carolina --Mr. H. E. Miller, director, bureau of engineering and inspection.
Ohio -----------Mr. W. H. Dittoe, chief engineer, division of sanitary engineering.
Pennsylvania----Mr. C. A. Emerson, chief engineer, division of engineering.
Rhode Island----Mr. Stephen DeM. Gage, chemist and sanitary engineer.

Representatives of the State health departments—Continued.

South Carolina--Mr. E. L. Filby, State sanitary engineer.
Tennessee -------Mr. C. N. Harrub, State sanitary engineer.
Virginia ---------Mr. E. H. Gage, sanitary engineer.
Washington-----Mr. C. E. Dorisy, State sanitary engineer.
West Virginia---Mr. Ellis S. Tisdale, director, division of sanitary engineering.

Representatives of United States Public Health Service:

Associate Sanitary Engineers C. N. Harrub, Sol. Pincus, and A. F. Allen.
Assistant Sanitary Engineers A. E. Gorman, Joel I. Connolly, and I. W. Mendelsohn.
Junior Assistant Sanitary Engineer E. C. Sullivan.

Guests:

Mr. George C. Whipple, professor of sanitary engineering, Harvard University.
Mr. H. W. Clark, director and chief chemist, division of water and sewage laboratory, State Department of Health, Massachusetts.
Mr. Bertram Brewer, assistant engineer, Massachusetts Department of Health.
Mr. Arthur D. Weston, assistant engineer, Massachusetts Department of Health.
Mr. Melvin C. Whipple, instructor, Harvard University.
Mr. M. P. Horwood, instructor, Massachusetts Institute of Technology.
Dr. L. Williams, United States Public Health Service.
Mr. Hearne, assistant sanitary engineer, State Department of Health, Michigan.
Mr. R. S. Weston.
Mr. M. N. Baker.
Mr. William J. Orchard.
Mr. Pratt.
Mr. Leslie H. Allen.

In view of the absence of the regular secretary, Mr. Mendelsohn was appointed secretary of the meeting of the conference at Boston.

The report of the executive committee was made and approved.

A motion was made, seconded, and carried to appoint a committee to reconsider and modify the proposed draft of the constitution of the conference. The committee consisted of Mr. Horton, chairman, Mr. Dittoe, Mr. Tisdale, Mr. Filby, and Mr. Harrub.

REPORT OF CORRESPONDING SECRETARY OF THE CONFERENCE OF STATE SANITARY ENGINEERS FOR THE YEAR ENDING JUNE 1, 1921.

At the Conference of State Sanitary Engineers held in Washington on May 23 and 24, 1920, request was made of Assistant Surgeon General A. J. McLaughlin by the officers of the conference that the Public Health Service sanitary engineer stationed at the bureau be detailed as corresponding secretary of the Conference of State Sanitary Engineers to collect, analyze, and report to all State sanitary engineering divisions data on the prevailing and proposed activities in sanitary engineering. Such an arrangement was agreed to by Dr. McLaughlin, but the statement was made by him that such work as might be accomplished by this sanitary engineer in such capacity was entirely in behalf of the conference and had no connection officially with the bureau.

Associate Sanitary Engineer Pincus became the first corresponding secretary and acted as such until September 1, 1920, when, upon his being detailed elsewhere, Assistant Sanitary Engineer Mendelsohn, who was stationed at the bureau, became corresponding secretary.

Following the desires of the conference, as expressed at the 1920 meeting, efforts were made to transmit information of the work done by each State sanitary engineering division to all the others. Later, upon investigation of the literature on sanitary engineering available to the State sanitary engineers, and, in view of the finding that but few technical journals are used by the State sanitary engineers, it was decided to cull the technical journals of this country, Canada, England, and other nations and transmit abstracts on important articles on sanitary engineering to all the State sanitary engineers. One of the important results of this investigation was that no technical journal of this country covered the sanitary engineering literature of the world as adequately as the matter required, and that valuable foreign contributions on malaria, water treatment, sewage disposal, and other sanitary engineering subjects were not being brought to the attention of the sanitary engineers of this country. It is now endeavored to correct this condition by furnishing weekly public health engineering abstracts, primarily for the use of the State sanitary engineers. It might be added that these abstracts have fulfilled their purpose in several instances already, notably concerning present procedure in malaria measures in the United States and regarding alum treatment of water.

Since October 30, 1920, 1,278 copies of 28 separate bulletins, issued either by State sanitary engineering divisions or other bodies or persons, but all concerning sanitary engineering, have been forwarded through the corresponding secretary to all the State and Government sanitary engineers; and abstracts of over 200 articles on sanitary engineering from the journals of 69 separate technical publications have been mimeographed and sent to the sanitary engineers. Besides these technical publications, many reports of interest to sanitary engineers are available from other nations. The mailing list for the public health engineering abstracts has increased from 82 names on January 1, 1921, to 168 on May 28, 1921, simply as a result of compliance with requests of sanitary engineers for copies.

Other work accomplished included the mimeographing and transmission of questionnaires, forwarding replies for the conference's committees, and assistance with the program for this conference.

It is believed that if a little time is regularly devoted by each State sanitary engineer to forwarding to the corresponding secretary information concerning sanitary engineering matters of interest to the other sanitary engineers, for instance, such as an interesting experiment observed by the sanitary engineer, the sum total of benefits to each sanitary engineer will be large indeed.

Mr. Robert B. Morse, chief engineer, Maryland State Department of Health, presented the following paper:

SOME PRODUCTIVE ACTIVITIES OF A STATE SANITARY ENGINEERING OFFICE.

The measure of the effectiveness of any activity of a State bureau of sanitary engineering may be evolved from a consideration of the probable effect of such an activity upon sickness and death rates from individual or general diseases. As a corrollary to this statement it may be assumed that that activity is most effective which influences the public health to the greatest degree and at the least cost. It naturally follows that, with activities of equal inherent sanitary importance, that which influences the greatest number of people is the most effective. It is true that local conditions and prejudices are modifying influences, but in general the above principles may serve as satisfactory guides for engineering activities.

With this basis of satisfactory performance in mind, it is interesting to note certain variations of procedure of State engineering organizations in apportioning activity and funds. When the engineer finds himself in the position of determining the direction his future or present activities should take, he sometimes seems to have no definite plan of procedure or process of elimination by which he arrives at a conclusion. If one surveys the field of State engineering activity, it is not at all rare to find unbalanced distributions of energy in such fields as comfort station control, swimming pool sanitation, ventilation control, and other functions whose public health implication either is perhaps decidedly hazy or does not affect a large proportion of the public. Engineering bureaus whose force and budget are so large as to permit them to run the gamut of all popular and ephemeral campaigns are rare. Where they exist it may be wise to extend activities to such fields as may be open for the development of esthetic standards, even where the public health advantages therein are only slight. Unfortunately, however, most State organizations are not in the above class, with reference either to funds or to men. They must, therefore, justify the allocation of a large part of their appropriation to a very small proportion of the population, if they carry on such campaigns. Without such a justification it would certainly appear that energies devoted to comfort stations or ventilation, for example, by a small and inadequately financed bureau are misdirected, to say the least. This conclusion, no doubt, will arouse opposition, but should it not stand until the greater relative sanitary importance of comfort station and ventilation activity, as against, for example, that of adequate water-supply control, has been amply demonstrated? In so doing the requirements of public comfort should not be confused with those of the public health.

In similar fashion, we may well ask how much time and money should be expended on such activities as sanitary privy campaigns and railroad and steamboat water supply certification. While the public health importance of these examples is more apparent, the factors of cost and proportion of public affected play a predominating part.

If but a fraction of the time and money that are expended in some sections in an effort to have sanitary privies installed in thinly populated rural districts, or in ill-considered campaigns to have them used throughout villages and towns where complete sewerage systems could be constructed and operated at little, if any, greater individual expense, how much greater would the total sanitary value be. How many more people would be benefited by the construction of a few adequate sewerage systems than by the installation of many sanitary privies. If, also, as much time were given to original investigations in the field of design and operation of water purification works as to consideration of relative values of pet types of sanitary privy, how much broader would be the public health benefit.

The above brief analysis of engineering activity and its public health evaluation seems necessary as an introduction to a discussion of some productive activities of State bureaus. It is not the intention to enumerate all of such activities, but to outline only two forms thereof which have demonstrated their usefulness in Maryland.

The functions of a State bureau of sanitary engineering are those of regulation, development, and investigation. In this paper it is assumed that the powers of supervision over plans exist, for without these it is usually difficult to carry out any effective program of work. We further assume that those who are charged with the approval of plans are of sufficient engineering competency and experience to be able to perform this duty successfully. With incompetent and inexperienced regulatory examination of plans, or with only casual inspection, as is apt to result from unfamiliarity with the problem, this feature of State control will be a failure. We may pass, therefore, to a consideration of the functions of development and of investigation.

The development work in Maryland has for its purpose the installation and extension of public water supply and sewerage systems. This activity is considered of sufficient importance to be provided for as a major division of the bureau. This division has an educational object in the large sense. It aims to promote, for individual towns or combinations of communities, the use of adequate water and sewer systems. It accomplishes this result by a variety of methods, which include the preparation of preliminary plans, of cost estimates, of methods of financing, and the presentation of these and other pertinent data to the communities concerned. The preparation of prelimiary plans was found essential in order to be able to present an intelligent case to the people, to picture to them the location of lines, to demonstrate practicability, and to prepare a fairly accurate cost estimate. By performing the above function, the bureau aids the popular mind in visualizing the concrete system. It becomes easier then to have the town engage the private engineer to prepare complete plans and to obtain necessary bond issues. By stimulating in the above manner the installation of systems in many towns that would not otherwise act, the State aids rather than retards private engineering activity. At the same time information is obtained which permits of a more intelligent survey of the plans later filed by the outside engineer.

With preliminary plans at hand the problem of arriving at a fair estimate of the cost of the improvement to the community is simplified. The importance of this second step in development work can not be too strongly emphasized, since the factor of cost is usually the one which most influences local action. Often the public health argument has but little weight, while low capital and maintenance cost may carry the day. Abstract argument as to the desirability of adequate water and sewerage systems seems to have little influence at least upon Maryland local authorities. Financial rather than health factors almost always control.

Since the mind of the public is apparently considerably more impressed by a dollar than by a death, it becomes necessary for the State to adjust its talking points accordingly. This psychology can not be ignored and, because of it, considerable thought has been given to the development of practicable and just methods of financing water and sewerage systems. Here again human nature predetermines and directs the line of action necessary. It has been made clear to us in most campaigns that the individual rarely is concerned with community welfare. Now and then, a Utopian figure appears whose interests are communal, but most often the individual is interested in the cost to himself. On this account an effort is made to work out for each property holder in the smallest communities, and for standard units of property in larger places, the total annual cost which will result from the introduction of a new system. This can be done when there are available preliminary plans, detailed cost estimates, and information concerning the character, size, and value of individual properties.

It may be of interest to point out that more effective results are obtained by quoting fire insurance rates before and after installation of a water system, than by mere reference in general terms to public health benefits. By the same process of appealing to the individual's pocketbook instead of to his heart, it is usually wise to keep the total cost of a project in the background, while emphasizing the low annual cost to individual property holders.

The plan of financing advocated for both water and sewerage systems need not be gone into in detail here. Its general principles are as follows:

Public and private benefits are separately considered. The payments of fixed and operating charges are kept distinct. The annual cost of the bond issue for constructing both systems is met by a combination of property tax, annual front-foot assessment, and house connection charges; the cost of maintenance of both, by meter service and water consumption rates. These various charges are distributed in such manner that the expense falling upon any individual, public or private, is as nearly as possible proportionate to the benefits which he derives.

It has no doubt already been made evident that the program of development here outlined is a conscious one and is the result of previous planning. It is not intermittent, but continuous and selective. Towns for intensive attention are carefully chosen on the basis of population, sanitary needs, and financial status. Close study of each case from various viewpoints is carried out. The process of development is a deliberate one in which field and office studies and public presentation and discussion alternate and mingle. By devoting a separate division's activities to such work, assurance is had that the campaigns are well thought out and successive and, in this manner, discontinuous, haphazard excursions with general facts are avoided. Special knowledge of each local problem is acquired before and during each campaign. The method of attack in this way acquires at least a scientific aspect and the work should bring fruitful results.

Another phase of State engineering activity which is often ignored, but which has proven its usefulness in Maryland, is that represented under the general head of investigations of special character. The term "research" is here avoided, because of its restricted connotation. Research too often is thought of as conducted in the laboratory on a basis too academic to be practical. Special investigation, however, as a part of the bureau's function, has a much wider application. It has no restrictions made by official division or by impracticability. As we consider it, special investigation is concerned with problems of design, construction, and operation, and with questions of administration. It should include laboratory, office, and field observations. It is necessarily broad, since the State should act as the principal reservoir of information regarding sanitary engineering facts. If it is to serve as this source it must collect data, carry out experiments, develop new methods, interpret existing phenomena, and suggest new principles. This composite function can not be successfully sandwiched in amongst other duties; it demands concentrated and continuous application. As in development work, this activity also requires a special viewpoint and a new body of facts, usually different from those gathered either in administrative or development work.

The justification for the expenditure of time and money for this general class of investigative effort is of several kinds. In the first place no other body exists for the proper development of such data, for their coordination, or for their interpretation. Communities desiring advice turn to the State bureau. It should have available at all times the most complete and recent information upon any sanitary engineering problem in order to carry on its other work competently. In addition, such information must be selected and accurate. The establishment of such a clearing house demands specialization.

Besides the clearing-house function, which investigation supports, special studies also provide for economy of design and operation. They introduce new concepts and procedures which aim at all times to decrease costs and to increase efficiency. Their public-health value is easily measurable if one stops to consider that a new fact learned or an old theory modified may mean the construction of a water-treatment plant and the consequent change from an inferior supply to one of good quality. If investigation should lead to the reduction in cost of any sanitary engineering structure it has aided sanitation by more than the equivalent saving in dollars.

In any discussion of special investigations, we are naturally brought to a consideration of the part so-called "pure research" should play in State sanitary engineering duties. It should hardly be necessary to point out the absence of any transition point from pure to applied research. The two are usually closely allied and it is useless to speak of restricting oneself to either the one or the other. A certain appreciable amount of theoretical scientific study is required in every problem. There is little danger of converting the average State bureau into a cloistered student's chamber, when the demand for the solution of practical sanitary engineering problems is as pressing as it now is. In order to solve some of these, however, a definite scientific method is essential. Without facilities for such special studies, the organization is frequently seriously handicapped.

In the preceding pages an attempt has been made to outline two functions of State sanitary engineering service which are sometimes understressed. The creation of two separate divisions, development and investigation, on a parity with those of field and office, has its origin in the desire to round out the functions of the Maryland bureau. For the most part field and office activities, in the usual sense, are concerned with the natural progress of events; they carry on the current or routine duties. In order to make such duties more effective and broader it is necessary to develop new facts and new systems. Both office and field divisions are already engaged in a definite class of work. The requirements of progress demand additional specialized functions. It is these which the divisions of development and investigation perform. It is believed that their importance and their latent power for doing good have been made sufficiently clear.

Mr. W. H. Dittoe, chief engineer, Ohio State Department of Health, presented the following paper:

THE TYPHOID FEVER EPIDEMIC AT SALEM.

The epidemic of typhoid fever which occurred at Salem, Ohio, during the fall of 1920 is of unusual interest to persons engaged in public health work. This epidemic showed one of the highest case rates ever recorded and at the same time the mortality rate was the lowest of the important epidemics of the United States. The epidemic was caused through the medium of a public water supply which for many years had been of a high degree of purity and had never previously been held responsible for any water-borne disease. These features of the epidemic warrant a complete relation of the circumstances surrounding it and there is now in preparation an official report to be issued by the State department of health which will supply all details. Therefore, I shall not endeavor to discuss completely all phases of this epidemic and shall only relate the important circumstances, including a description of the water-supply system and the manner in which it became contaminated.

The city of Salem is located in Columbiana County in the northeasterly portion of Ohio at the headwaters of Little Beaver River, a tributary of the Ohio River. The population of the city is about 10,000. It has a thriving industrial development, but its rate of growth has been rather slow. In addition to its public water supply system the city has a system of sewerage constructed on the separate plan and also has a number of paved streets. The sanitary sewers cover practically all of the built-up area and serve a population of about 9,000. Sewage is delivered to a sewage-treatment plant located northwest of the city, consisting of tanks and intermittent sand filters, the effluent from which is discharged into a small creek. This plant is inadequate, and, moreover, it has been greatly overburdened due to the misuse of the sanitary sewers. The city has neglected to control sewer connections and as a result these connections have been established very carelessly and have permitted large volumes of surface and subsoil drainage to reach the sewers. In addition, there are several poorly constructed private sewers connected to the system. It will be shown later that the improper control of sewerage was a contributing cause to the occurrence of the epidemic.

HISTORY OF EPIDEMIC.

During the early part of September, 1920, an outbreak of enteritis occurred in Salem and was observed by the local physicians and the health commissioner. This outbreak was not intense, and as cases of intestinal disorders were more or less prevalent in other communities nearby no particular concern was aroused. It was thought by local physicians and health officials that the sickness was "intestinal influenza," but in the light of facts later learned the Salem cases were without doubt of a different kind and due to an entirely different cause. After partial subsidence of this outbreak, a second and much more intense outbreak of enteritis occurred, starting about September 23 and consisting of approximately 7,000 cases. Typhoid fever made its appearance about October 1 and after October 12 the typhoid fever cases increased very rapidly, the epidemic mounting to a peak on November 1. Thereafter, a rapid decline occurred. The total number of typhoid-fever cases which were reported and investigated was 884, including not only the epidemic cases but those which preceded and followed the epidemic, a period of two months. The total number of deaths resulting from the epidemic was 27. Figure No. 1 illustrates graphically the course of the epidemic.

While investigation showed that the typhoid fever epidemic started about October 1, the actual existence of typhoid fever within the community was not known until October 13. In the early part of October the city health commissioner issued a public warning that the water from the public water supply should be boiled, but this warning was only based upon a policy of playing safe and was not the result of knowledge that the water was contaminated. In fact, at that time the water supply of the city was still considered to be above suspicion owing to its previous history. The State department of health was called upon October 13, 1920, to investigate the enteritis outbreak and in connection with this investigation, which was conducted by an epidemiologist of the department, the existence of a few cases of typhoid fever in the city was learned. Circumstantial evidence pointed to the public water supply as the cause for the enteritis and accordingly a boiling notice was repeated on October 15 and request was made by the epidemiologist for an engineering investigation of the water supply system. This was conducted as promptly as possible and included field analyses of water samples. The results of this study are shown graphically by figure No. 2. The result of this investigation fixed the water supply conclusively as the cause of the epidemic and accordingly disinfection of the water supply with liquid chlorine was decided upon and started October 20. It is pertinent to observe that at this time the local health department knew of

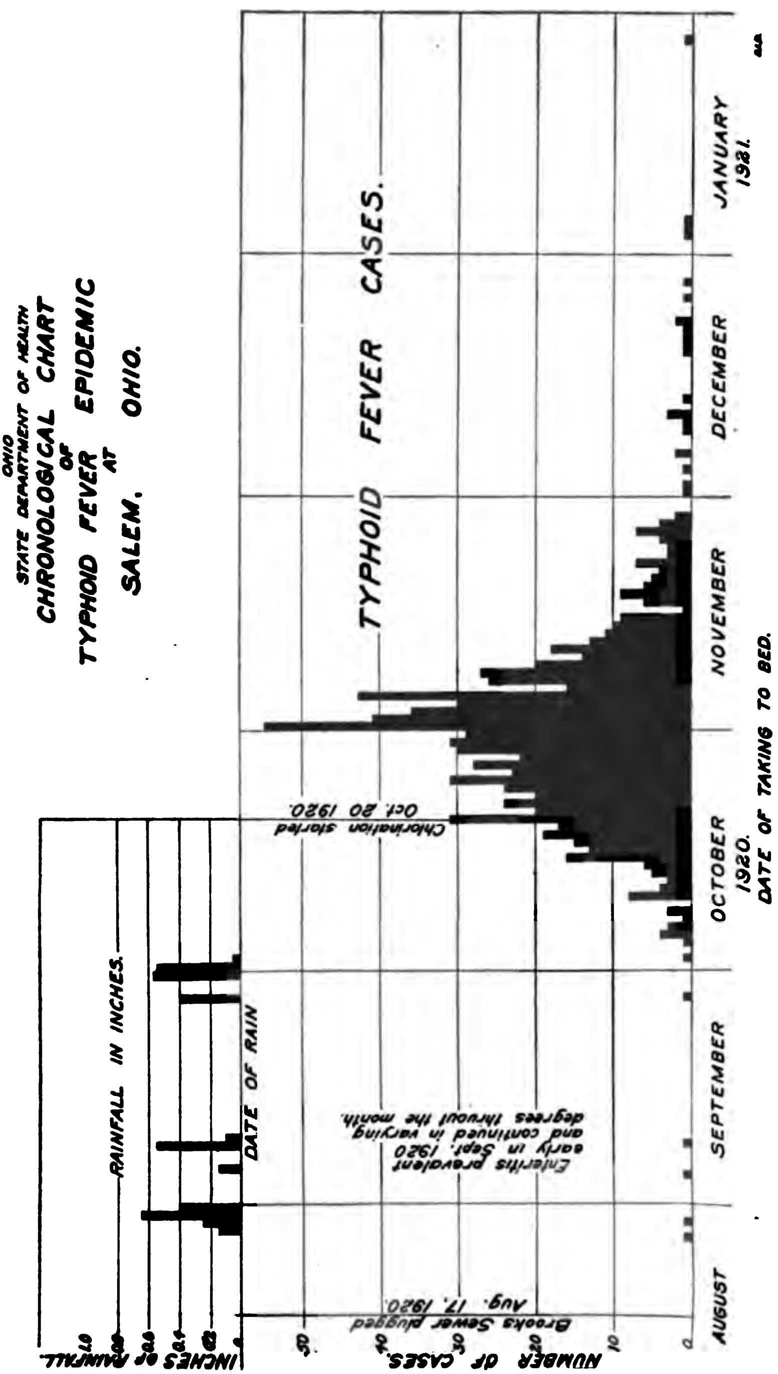
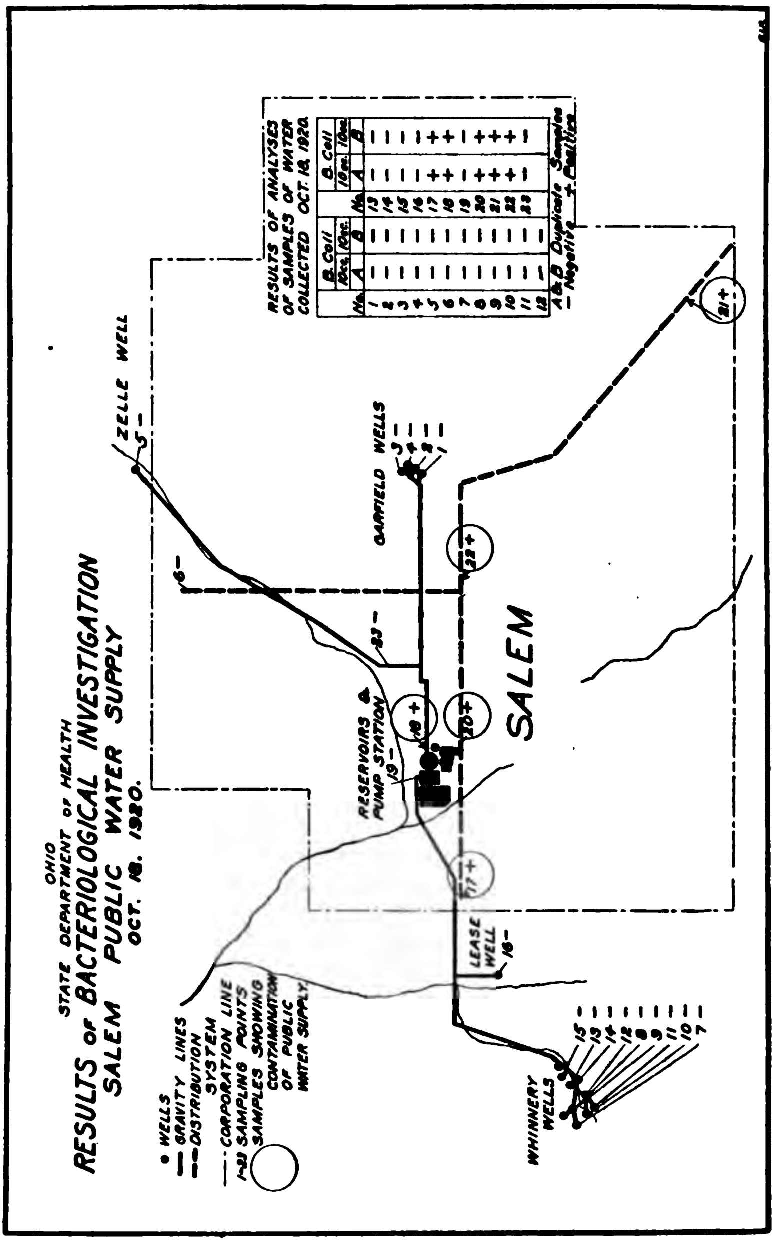

OHIO
STATE DEPARTMENT OF HEALTH
CHRONOLOGICAL CHART
OF
TYPHOID FEVER EPIDEMIC
AT
SALEM. OHIO.
TYPHOID FEVER CASES.
RAINFALL IN INCHES.
INCHES OF RAINFALL.
1.0
0.8
0.6
0.4
0.2
0
DATE OF RAIN
NUMBER OF CASES.
50
40
30
20
10
0
Brooks Sewer plugged
Aug. 17, 1920.
Enteritis prevalent
early in Sept. 1920
and continued in varying
degrees thruout the month.
Chlorination started
Oct. 20 1920.
AUGUST
SEPTEMBER
OCTOBER
1920.
NOVEMBER
DECEMBER
JANUARY
1921.
DATE OF TAKING TO BED.

Fig. 1.

only four cases of typhoid fever in the city, but as the subsequent studies demonstrated about 100 persons were suffering from the disease at the time whose cases had either not been diagnosed or had not been reported. The disinfection of the public water supply checked the epidemic. It of course did not affect those persons who



OHIO
STATE DEPARTMENT OF HEALTH
RESULTS OF BACTERIOLOGICAL INVESTIGATION
SALEM PUBLIC WATER SUPPLY
OCT. 18. 1920.

RESULTS OF ANALYSES OF SAMPLES OF WATER COLLECTED OCT. 18, 1920.

No.	B. Coli 10cc. A	B. Coli 10cc. B	No.	B. Coli 10cc. A	B. Coli 10cc. B
1	–	–	13	–	–
2	–	–	14	–	–
3	–	–	15	–	–
4	–	–	16	–	–
5	–	–	17	+	+
6	–	–	18	+	+
7	–	–	19	–	–
8	–	–	20	+	+
9	–	–	21	+	+
10	–	–	22	+	+
11	–	–	23	–	–
12	–	–			

A & B Duplicate Samples
– Negative + Positive

Fig. 2.

had received infection previous to October 20, but it prevented further infection, and subsidence of the epidemic occurred on schedule time. The size of the epidemic was not realized until the early part of November when reports of cases multiplied, and on November 9 at the request of the city officials the State department of health assumed charge of the local situation and sent representatives to make a thorough investigation and to apply necessary remedial measures to prevent the spread of the disease.

SANITARY INVESTIGATIONS.

When the representatives of the State department of health undertook the investigation on November 9, practically no accurate information regarding the epidemic was available except the knowledge that the public water supply had been the medium of infection and that by instituting chlorination on October 20 this cause of the disease had been removed. It became necessary, therefore, to institute a careful inquiry regarding the situation throughout the city, and for this purpose what has been termed a sanitary investigation was made. This comprised a visit to each occupied building within the city and in the built-up district surrounding the city, a total of 2,630 places. Informaton was obtained regarding cases of illness and the nature of the same occurring after September 1; the source of the water supply used prior to illness, the existence of a water service connection, a private well or other private source of supply, and the existence of a sewer connection, privy or cesspool. In addition, printed notices were left at each place, containing a warning to boil all water used for drinking and giving instructions regarding disinfection of stools from typhoid fever patients. This sanitary investigation would not have been possible had it not been for the earnest effort of the local war workers organization. By the united effort of the members of this organization, the sanitary investigation was practically completed during a period of 24 hours making the information promptly available. The results of this sanitary investigation gave information which was the basis upon which the epidemiological investigation was made and the various remedial measures were applied to check the spread of the disease.

EPIDEMIOLOGICAL INVESTIGATION.

Starting on November 9 and continuing until the epidemic had subsided, a careful and thorough epidemiological investigation was made of each case. The usual information regarding each case was secured, consisting of the date of first symptoms, the date taken to bed, the location of the case, the sex, age, and color, and an inquiry to determine the possible exposure factors during the period when the disease was contracted. These factors included the milk supply, the food supply, the water supply, the attendance at public gatherings, and the opportunity for contact infection. I shall not endeavor to present any details of the results of the epidemiological investigation. All sources of infection were clearly eliminated, except the public water supply of the city, which was found to be the common factor. The chronology, distribution, and general character of the epidemic also pointed to the public water supply as the cause. Therefore the evidence established the epidemiological diagnosis "that the contamination of the public water supply was the cause of the epidemic."

DESCRIPTION OF WATER SUPPLY.

The following description of the public water supply system of Salem applies to the system as it existed prior to the epidemic and does not include the changes or improvements made subsequently. The Salem Water Co. started the development of the present system in 1887, continuing its ownership until 1899, when the Salem Water Works Co. succeeded to ownership. In 1909 the system became the property of the city. The water supply is obtained from four general sources, as follows: The Garfield Avenue wells, located immediately northeast of the central portion of the city; the Whinnery wells, located approximately one-half mile west of the city; the Lease well, located approximately one-quarter mile west of the city; and the Zelle well, located immediately north of the city. The water is lifted from the various wells either by air-lift or deep-well pumps and delivered by gravity lines to storage reservoirs located near the main pumping station in the westerly portion of the city, and from these reservoirs the supply is pumped to the distributing system. The general locations are shown by figure No. 2.

The Garfield Avenue wells are very poorly located, being on a tract of land occupied by a high-school building and in a district which is entirely built up with residences many of which are accompanied by privies and abandoned private wells. There are also sewers and other contaminating influences near the wells. Wells were developed at this site as early as 1882, before the water company assumed control, and these were continued in use until 1898, when additional wells were drilled and the old wells deepened. At this time the water was pumped from the wells directly into the distributing system, but in 1900 air-lift equipment was installed to pump the wells and a gravity line was constructed extending from the site of the wells to the reservoirs at the main pumping station. The wells have been operated in this manner since 1900. The Garfield Avenue wells are 265 feet in depth, penetrating 12 feet of clay, 100 feet of brown sandstone, 80 feet of fire clay or soapstone, and extending the rest of the way through white sandstone. The casings

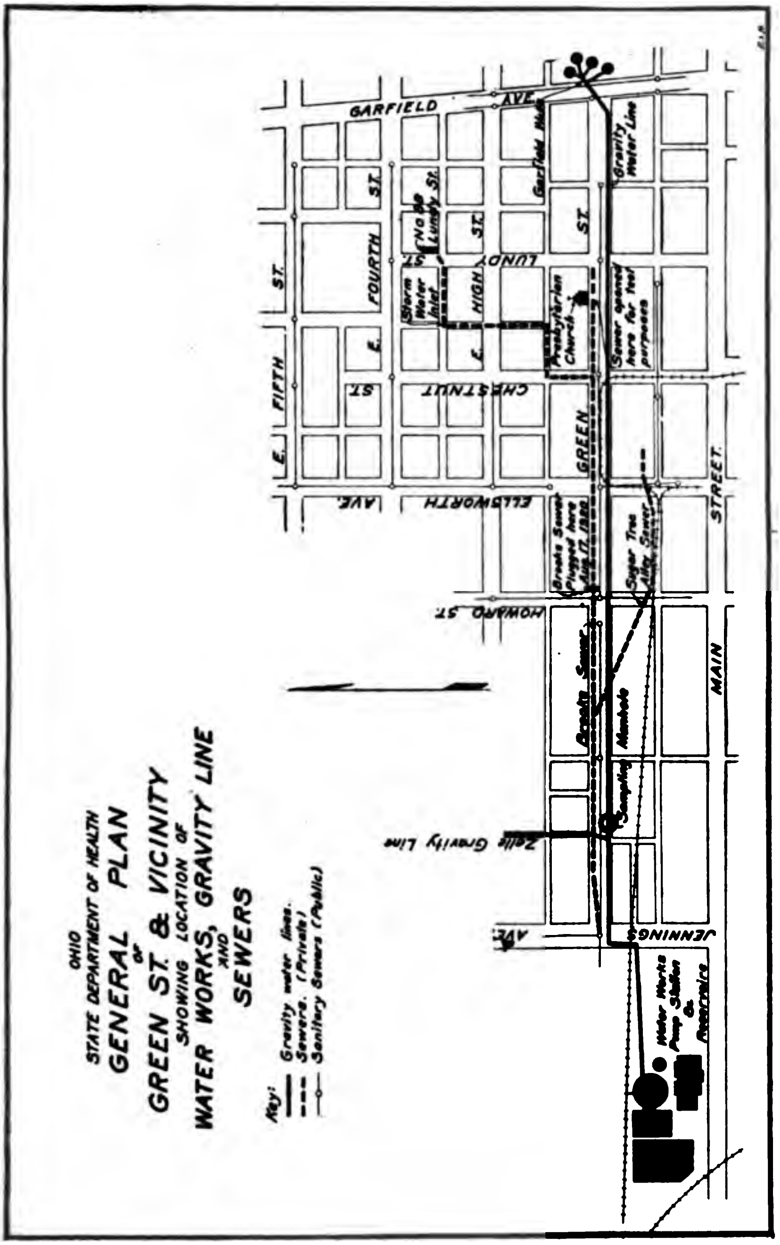


FIG. 8.

of the well extend to a depth of about 100 feet and the water is mainly derived from the white sandstone. The gravity line has a total length of 3,400 feet and is constructed of 12-inch vitrified saltglazed double-strength sewer pipe in 3-foot lengths, with deep and wide sockets. Joints were made with cement. The line extends in Green Street and Jennings Avenue, both of which are almost completely built up, and there are numerous sources of contamination of the shallow ground water along the route of the line. Private and public sanitary sewers parallel and cross the line and are at points at elevations higher than that of the gravity line. The location of the gravity line is shown by figure No. 3. The Garfield well development is unsatisfactory on account of the unfavorable location of the wells themselves and also on account of the use of a gravity line which subjects the water to dangerous contamination. While these conditions were recognized to be potentially dangerous, they had not caused trouble prior to the epidemic. Samples from the wells collected at various times during the past 20 years have given satisfactory results and this is also true of samples collected from the reservoirs receiving the discharge from the gravity line.

In 1903 it became necessary to increase the water supply and the Salem Water Works Co. started the development of the Whinnery wells at a point about one-half mile west of the city. The original installation comprised six wells and five additional wells have been installed from time to time since 1903. The site of the wells is satisfactory. The surrounding country is open farm land and there are no near-by sources of contamination. The wells are 180 feet to 200 feet in depth, penetrating 85 feet of clay, 80 feet of white sandstone, a few feet of limestone, and a stratum of black slate. The supply is obtained from the white sandstone formation. Four of the wells are pumped by deep-well pumps and six of them are pumped by air lift. The water is discharged into a gravity line which extends a distance of some 5,700 feet in an easterly direction to the reservoirs at the main pumping station. This gravity line is well constructed of 10-inch cast-iron pipe with leaded joints and is probably water-tight. The fittings at the top of the casings of the wells equipped with deep-well pumps are apparently tight. Brick cisterns with plank covers are placed around the tops of the wells pumped by air lift. The covers are not securely fastened and are not tight, and the cisterns in general have been permitted to deteriorate so that the water as discharged from the wells is exposed to possible contamination. This is the only unfavorable sanitary feature of the Whinnery well development. Samples from the Whinnery wells have always shown this supply to be of excellent sanitary quality.

The Lease well, which is located about one-quarter mile west of the city between the Whinnery wells and the city, was developed in 1914 and is similar to the Whinnery wells. It is pumped by air lift and is provided with a brick cistern. The same comment made in regard to cisterns at the Whinnery wells applies to this development. Samples from the Lease well have always shown freedom from contamination.

During 1916, the city increased the available water supply by drilling wells on the Zelle farm, located immediately north of the city. The location of these wells is satisfactory and the city owns a 24-acre farm at this point. Only one well is now in service. This is approximately 180 feet in depth and penetrates 35 feet of sand and gravel, 5 feet of shale, an unknown thickness of brown sandstone, and an underlying soapstone formation. The well is plugged at a depth of 165 feet. The water is obtained from the brown sandstone formation. The well is pumped by direct suction, the water being discharged into a gravity line constructed of 6-inch cast-iron pipe with leaded joints and extending from the well site in a general southwesterly direction to a connection with the old vitrified pipe gravity line serving the Garfield Avenue wells. From this point the combined flow of the Garfield Avenue wells and the Zelle well is conveyed in the vitrified pipe line to the reservoirs at the pumping station. The tops of the wells at the Zelle farm are not securely closed to prevent entrance of chance contamination, but otherwise the well development is satisfactory. The gravity line is poorly located as it extends along the banks of a small stream and is, therefore, subject to washout. Evidence also indicates that the joints of this line were not made properly and that many of them are leaky.

The water from the various sources of water supply delivered through the gravity lines is received in storage reservoirs constructed at various times between 1887 and 1917. These comprise reservoir No. 1, a circular structure 91 feet in diameter and 12 feet in depth with a stone wall and a concrete bottom and cover; reservoir No. 2, a rectangular structure 100 feet by 70 feet in plan and 14 feet deep with concrete floor, walls, and cover, and reservoir No. 3, a rectangular structure 159 feet by 107 feet in plan and 10 feet deep with concrete floor, walls, and cover. In addition, there is a pump well 36 feet in diameter and 16 feet deep with a concrete floor, brick walls, and timber cover from which the pump suction is normally taken. The reservoirs are so connected that water may be discharged into either reservoir No. 1 or No. 2 and may be drawn to the pumps from the suction well or from reservoirs No. 2 or No. 3. The general arrangement of the reservoirs is shown in figure No. 4.

The condition of the reservoirs and suction well is not satisfactory. The bottoms of all of the reservoirs are in a leaky condition and the walls of reservoirs No. 2 and No. 3 and of the pump well are also leaky. This permits the entrance of shallow ground water into the reservoirs when the water within them is lowered to an elevation below that of the surrounding ground water. This is of particular importance when it is known that the reservoirs are located at about the lowest elevation within the city, to which

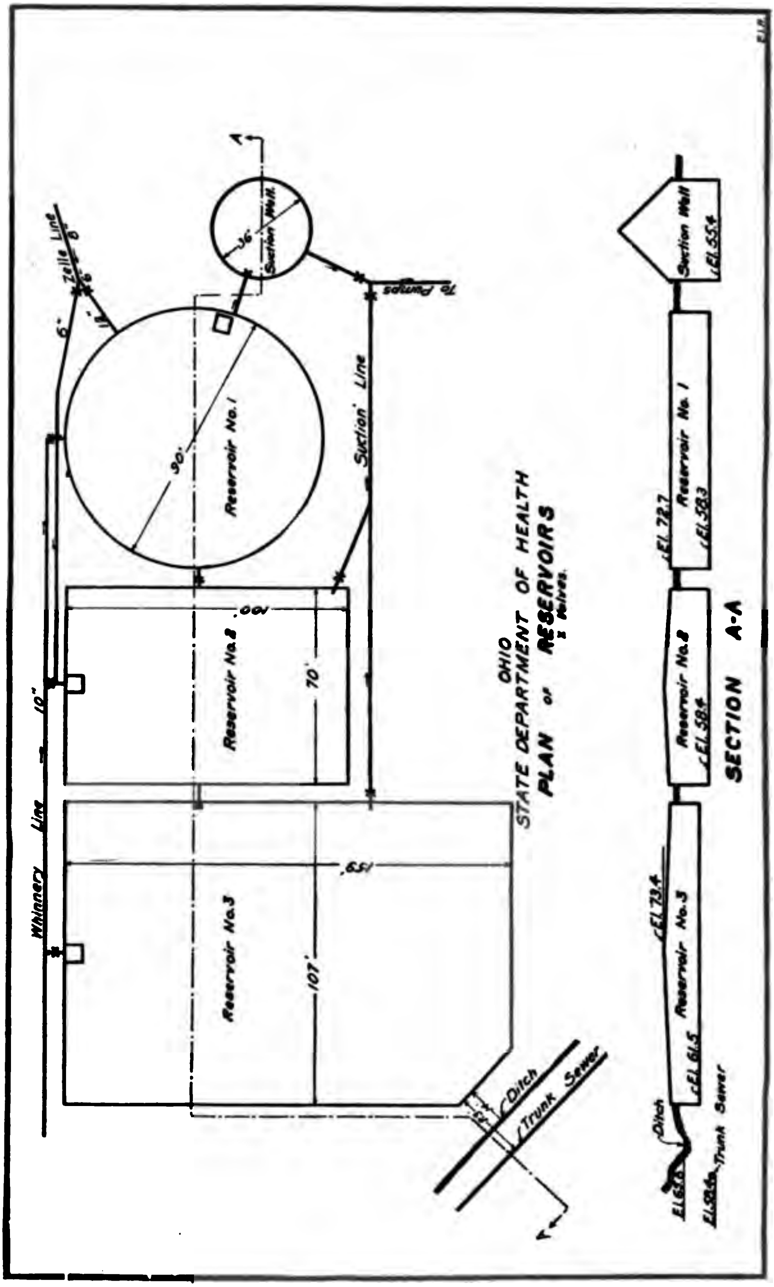


FIG. 4.

vicinity practically all of the natural and artificial drainage is directed. The main trunk sanitary sewer of the city passes reservoir No. 3 at a distance 23 feet from its west wall.

The water supply is in general use by the citizens of the city and prior to the epidemic was popularly accepted as a pure supply. It is also made available to the industrial plants of the city which generally maintain private supplies obtained from wells similar to those of the city. Careful investigation revealed existence of a number of cross connections with the public supply.

Summarizing the above description of the water-supply system of the city, it will be noted that while the water had for a number of years been considered safe due to favorable analyses and absence of outbreaks of water-borne disease, there existed at the time of the epidemic a number of defects in the development of the system. For convenience these will be repeated as follows:

1. The location of the Garfield wells is unsafe.
2. The gravity line serving the Garfield Avenue wells is of unsafe construction, probably not water-tight, and as it passes through the built-up portion of the city the water supply is thus rendered subject to contamination.
3. The tops of the various wells are not securely closed.
4. The iron pipe gravity line serving the Zelle well is poorly located and has poorly leaded joints.
5. The reservoirs have leaky walls and bottoms, subjecting the water supply to danger of contamination by shallow ground water.
6. Connections to the waterworks mains exist whereby private water supplies may reach the distributing system.
7. While not directly connected with the sanitary safety of the water supply, mention must be made of the inadequacy of the supply which has caused several severe shortages during recent years.

MANNER IN WHICH THE WATER SUPPLY BECAME CONTAMINATED.

Recognizing the various defects of the waterworks system it became necessary to determine beyond reasonable doubt the manner in which the public water supply became contaminated and thus caused the epidemic of typhoid fever. The investigations and studies of this matter required much time and painstaking care and obviously consideration of each defect was demanded. The first investigation made October 18 and 19, including bacteriological examination of samples, indicated that the contamination was reaching the water supply through the vitrified pipe gravity line serving the Garfield Avenue wells and these results warranted the presumption that this was the cause of the epidemic. Figure No. 2 shows these results. Accordingly, in addition to chlorinating the water supply, beginning October 20, the use of this gravity line for the Garfield Avenue wells was terminated October 27 as soon as pumping equipment could be delivered directly into the distributing system. It was necessary to continue the use of the lower portion of the vitrified pipe gravity line for conveying the water from the Zelle well until December 3, when a new cast-iron line was completed. A careful consideration of the various defects of the waterworks system finally eliminated all causes for contamination except the vitrified pipe gravity line. Taking up each of the defects it may be advantageous to indicate how they were eliminated.

The possibility of deliberate or accidental contamination of the water supply through the tops of the well casings can not be eliminated definitely, but this does not appear as a probability, particularly in view of the fact that the history of the epidemic indicates that the water supply was infected on more than one occasion during the time the outbreak was developing.

Direct contamination of the Garfield Avenue wells probably did not occur, as samples collected from them for a long period of years prior to the epidemic and during the period of investigation after the epidemic started did not show contamination.

The cast-iron-pipe gravity line serving the Zelle well under certain circumstances might have admitted contamination through a leaky joint, but this possibility is removed by the evidence that the line was under internal pressure continuously from the spring of 1920 until October, 1920, at points where it would be possible for contamination to reach the line. Furthermore, analyses of samples from this line failed to show contamination.

The cross connections on the distribution system permitting discharge of water from private industrial water supplies are not held accountable due to the fact that these supplies are generally of the same character as the deep-well supplies of the city, and, furthermore, the distribution of cases throughout the city would not correspond with contamination in this manner.

In spite of the unsatisfactory construction of the reservoirs and pump well at the main pumping station, a careful investigation produced evidence showing that these structures were not responsible for the typhoid fever outbreak. Evidence was obtained showing that at no time during the summer of 1920 did the level of water in the reservoirs fall below that of the shallow ground water surrounding them. A test was conducted to determine whether it would be possible for sewage to pass from the main sanitary trunk sewer of the city to reservoir No. 3. This was done by plugging the sewer so as to place it under a head of 6 feet, adding at the same time to the sewage a considerable quantity of uranine, which is a very intense green dye. Previously, reservoir No. 3 had been completely emptied, and it was noted that shallow ground water seepage entered through the walls and bottom. This condition was permitted to continue for slightly more than one hour, and samples of the seepage reaching the reservoir were regularly collected, but failed to show evidence of the uranine color.

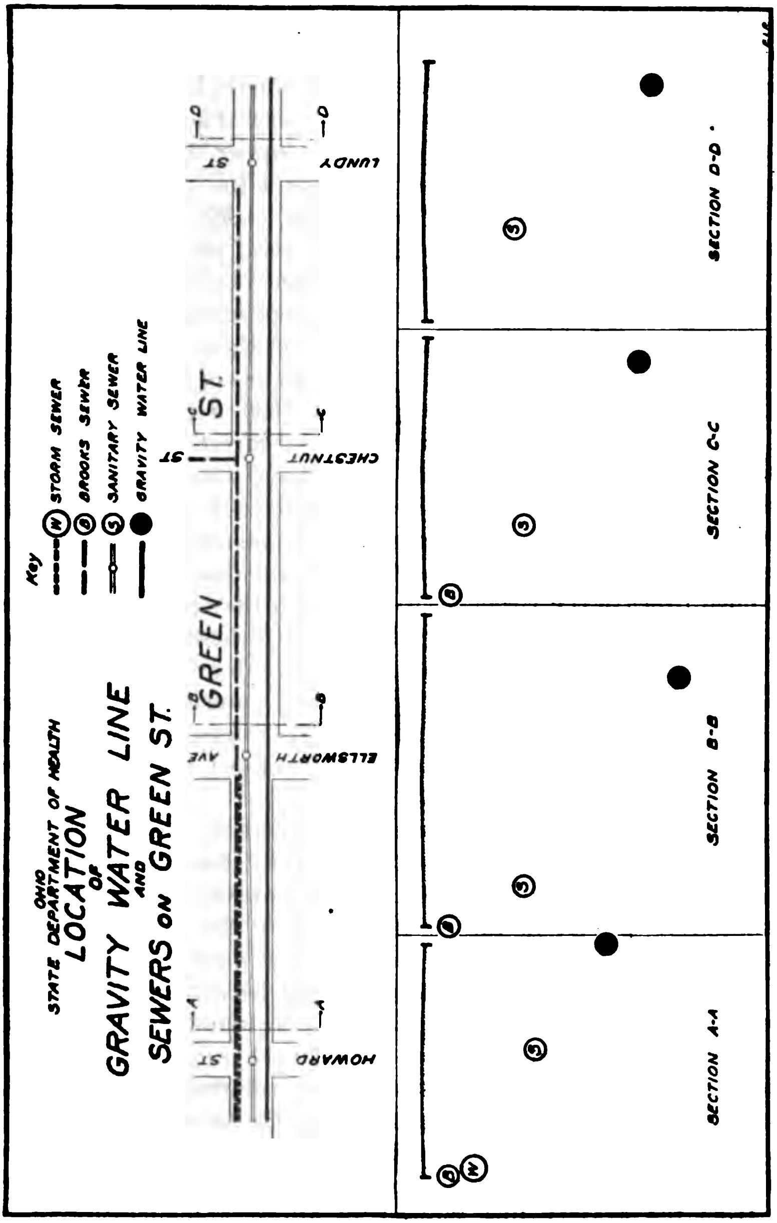


FIG. 5.

The study of the vitrified pipe gravity line serving the Garfield Avenue wells gave conclusive results that the water supply was contaminated by leakage of sewage into this line. This line extends in

Green Street and is paralleled by a sanitary sewer, a storm sewer, and two private sewers. One of these private sewers, known as the Brooks sewer, was installed a number of years ago for private use, but was later connected to the sanitary sewer system of the city and was continued in use as a combined sewer. Not only did it receive sewage from a number of residences and a church, but it also received the surface run-off from a built-up area of several acres, this reaching the sewer through a catch basin near its upper end. The Brooks sewer was constructed with open joints and the pipe was without bell ends. It, therefore, must have been leaky. A storm sewer parelleling it had discharged sewage for several years and a nuisance had been created at the outlet. This sewage was probably reaching the storm sewer by seepage from the Brooks sewer. An effort was made by the employees of the city to correct these conditions, but it was impossible to discover what dwellings were connected to the Brooks sewer. Therefore, on August 17, 1920, a plug was inserted in the Brooks sewer at Howard and Green Streets by employees of the city, with the thought in mind that sewage would back up in this sewer and flood cellars of dwellings connected to it, thus bringing about complaints which would expose the existence of connections to the sewer. However, no complaints arose and apparently the sewage continued to leave the Brooks sewer through the open joints without backing up sufficiently to flood cellars. With these conditions existing heavy rainfall occurred during the last four days of August, 1920. This was followed by an outbreak of enteritis. Other heavy rains occurred September 9, September 27, September 30, and October 1, and apparently were the forerunners of the typhoid-fever epidemic.

While all of the evidence strongly pointed to soundness of the belief that the Brooks sewer and the gravity line were the causes of the epidemic, it appeared necessary to prove the possibility of passage of sewage from the Brooks sewer to the gravity line. In an effort to do this a sampling manhole was placed on the gravity line near its lower end, where the seepage leaving it could be observed, sampled, and measured. It was soon found that the seepage was contaminated ground water and that the rate of flow was influenced by rainfall. A concentrated salt solution was introduced into the Brooks sewer above the plug and at the same time the Brooks sewer was filled with water from a fire hose to imitate surcharging such as would be caused by rainfall. Careful examination of samples from the gravity line showed an appreciable increase in the chlorine content, 30 parts per million being present before the test and 46 parts per million after the salt was applied. This was not considered to be sufficiently conclusive, and further tests were made using uranine. This was applied at the storm-water inlet to the

Brooks sewer, at the same time filling the sewer with water from a fire hose. Within two hours after this dye was applied at the storm-water inlet a definitely noticeable green discoloration appeared in the seepage from the gravity line at the sampling manhole. Allowing for the time for flow in the Brooks sewer and in the gravity line between the storm-water inlet and the sampling manhole, the time for transfer from the Brooks sewer to the gravity line could not have exceeded 30 minutes. These investigations established conclusive evidence that the typhoid epidemic at Salem was caused by the passage of sewage from the Brooks sewer to the gravity line. Important confirming evidence is furnished by the fact that about October 1 there was a case of typhoid fever in a dwelling connected to the Brooks sewer, the stools from which were flushed directly into this sewer.

MEASURES TAKEN TO CONTROL THE EPIDEMIC.

The placing in operation on October 20 of a disinfection plant to treat the public water supply of the city at the main pumping station effectually checked the epidemic. This was the most important step taken to prevent the continued spread of the disease. Added safety was secured by abandoning the use of the vitrified pipe gravity line for delivery of water from the Garfield Avenue wells on October 27 and by the reconstruction of the lower end of this line, using cast-iron pipe, which was placed in service for the delivery of water from the Zelle well on December 3. An added measure of safety was provided by placing in operation on December 11 a liquid chlorine machine to treat the water pumped from the Garfield Avenue wells into the mains. Daily analyses of the water as delivered to the consumers indicated that after the disinfection of the supply was started the water was safe for drinking purposes at all times.

Owing to the intensity of the epidemic, however, and particularly recognizing the results of the sanitary investigation, it was deemed advisable to place in effect other measures to prevent the spread of typhoid fever. The sanitary investigation revealed the existence of some 276 private dug wells, 127 private drilled wells, and many cisterns throughout the city. The majority of these wells and cisterns were old and unused prior to the epidemic, but owing to the suspicion which was aroused regarding the public water supply the people generally turned to private sources of drinking-water supply. Accordingly, it was felt that some definite measures should be taken to protect the inhabitants of the city from disease which might arise from the use of such private supplies, as such supplies were in constant danger of contamination by the discharges of typhoid fever patients. Public warnings were given against the use of dug wells and springs, and in addition 100 dug wells and 37 cisterns were disinfected by applying to each 1 pound of hypochlorite of lime. This effectually prevented the use of such wells.

The sanitary investigation revealed the existence of 441 privies the most of which were of improper construction. As it was thought that many of these had been used by persons suffering from typhoid fever infection, it was deemed advisable to attempt disinfection of these privies. Accordingly, each privy vault in the city was treated with approximately 5 pounds of hypochlorite of lime.

Particular emphasis was placed upon the disinfection of stools from typhoid fever patients and to facilitate this, a supply of hypochlorite of lime in 1-pound tins was secured by the city and distributed without cost to families in which cases of typhoid fever existed.

It was not known what effect the sewage from the city might have upon the population downstream from Salem and it was deemed justifiable to attempt disinfection of the sewage at the sewage treatment plant. For this purpose, a dry feed chlorine gas machine was installed to treat the settled sewage. The amount of chlorine applied was approximately five parts per million which was the maximum capacity of the machine. No bacterial results are available to show the efficiency of this treatment. On the Ohio River below the mouth of Little Beaver River are several communities in Ohio and West Virginia obtaining their public water supplies from the stream. These communities were notified of the existence of the typhoid fever epidemic in order that they might take precautions in the treatment of their water supplies.

Pasteurization of the entire milk supply of the city was effected. Fortunately, a large milk depot had been established at Salem and was equipped with efficient pasteurizing machines making possible the treatment of the entire milk supply of the city. Regulations were also enforced prohibiting the leaving of milk containers at premises where typhoid fever existed, and prohibiting delivery of containers to purchasers at groceries and other places selling milk. These measures continued in effect until the epidemic had subsided.

Prevention of the spread of the disease through contact is attributable to the efficient public health and private duty nursing service which was provided. Over 300 nurses responded to the general call for help and as a result every patient in the city received daily nursing attention. Too much credit can not be given to the nursing service for the prevention of the spread of the disease through contact and for the low mortality rate.

Inoculation was generally taken advantage of by the people. It is estimated that at least 4,000 persons were inoculated. These included all of the food handlers of the city.

Unusual medical service attended the treatment of this epidemic. The 17 local physicians were assisted by 3 volunteer physicians from neighboring cities and 6 consultants. Dr. Henry A. Christian of Boston, Mass., did most to accomplish the proper treatment of the cases to which must be attributed in a large measure the low mortality rate. Hospital facilities included five hospitals, four of which were improvised. The total capacity, 180 beds, was taxed during the peak of the epidemic.

RECOMMENDATIONS MADE TO PREVENT A RECURRENCE OF THE EPIDEMIC.

The outstanding recommendations made by the State department of health to the city officials to prevent possibility of a recurrence of the typhoid fever epidemic relate to improvement of the public water supply system. The following were the principal items of advice regarding the water supply:

1. To continue chlorination of the water supply until improvements in the system could be made which would insure a safe water supply at all times.
2. To provide extensive improvements of the water supply system to insure an adequate water supply of good quality and pending the completion of such improvements to take the following steps:
3. To abandon permanently the Garfield Avenue wells, requiring increase of the other sources of water supply.
4. To abandon permanently the vitrified pipe gravity line. This has been done.
5. To repair the cast-iron pipe gravity line serving the Zelle well field.
6. To protect all wells from contamination by securely closing the tops of casings.
7. To abandon or make water-tight the storage reservoirs at the main pumping station.
8. To require abandonment of unsafe private wells.

The foregoing recommendations have not been fully carried out to date, but the city has learned its lesson and is taking steps to follow these recommendations fully.

In addition, recommendations were made to the city that legislation be passed providing for the proper control of the use of the sewers of the city in order to secure the use of the same in accordance with the purposes for which they were designed. Progress has been made looking toward the carrying out of these recommendations.

In order to provide proper control of the milk supply, sanitary inspection of dairies by the city was recommended and continued pasteurization of the milk supply to the city until the epidemic had entirely subsided.

LESSONS LEARNED FROM THE EPIDEMIC.

While the epidemic involved a great loss in life, money, and efficiency, it produced facts the recognition of which will prevent the occurrence of other epidemics of similar cause. The outstanding fact is the necessity of proper construction and maintenance of public water supply systems. No city can afford to overlook this fact. All features of construction and maintenance of the water supply system must be of highest standard to insure continuous safety. Another lesson learned is the necessity of analysis of the public water supply at regular intervals, regardless of its reputed quality. Had these lessons been learned and followed at Salem prior to the epidemic, it is safe to say that the epidemic never would have occurred.

As a result of the Salem experience the General Assembly of Ohio in 1921 passed a law intended to provide better control of public water supplies in Ohio. This law contains the following principal features:

1. It gives the State department of health general supervisory control of all public water supplies.
2. It requires the municipality or owner of the system to have analyses made regularly.
3. It prohibits dangerous emergency supplies and cross connections between public and private water supply systems.
4. It empowers the State department of health to require changes and improvements in public water supply systems to insure safety.

It is believed that the proper enforcement of this law will accomplish much in the prevention of water-borne typhoid fever in Ohio.

Afternoon Session, June 1, 1921.

The conference reconvened at 2 p. m., Mr. Whittaker presiding.

Mr. Dittoe submitted the following report:

REPORT OF COMMITTEE ON WATER SUPPLIES.

The committee on water supplies has given careful consideration of the proper subject to be treated in its first report to the conference and has decided that this report should be general in nature and should outline the activities which a State health department should conduct in undertaking comprehensive control of water supplies. In subsequent reports, technical and detail questions coming properly under the scope of this committee may be persented:

PRESENT PRACTICE OF WATER SUPPLY CONTROL IN THE VARIOUS STATES.

For the purpose of ascertaining the present activities and methods employed in the various States in the control of water supplies, your committee submitted inquiries to each State health department. Replies were received from 39 States and your committee has general information concerning the activities carried on in two of the States not replying. Your committee, therefore, has available information regarding all but seven of the States.

A review of the existing practice in the various States gives the following information: Some 35 States have established in their health departments a division of sanitary engineering. With the exception of a few of the older and more populous States the divisions of sanitary engineering are inadequately manned. At least 12 States have divisions comprising a single engineer and the great majority of the divisions include a chief engineer with one to five assistant engineers. In each State having a division of sanitary engineering, control of water supplies is practiced, the completeness and effectiveness of which varies with the adequacy of the personnel. The approval of plans for proposed public water supply improvements is required in almost all of the States, and in about half of the States the department is given the power to order improvements in public water supplies when found necessary. The extent of control of existing water supplies varies greatly in the different States, and in many of them practically no State control is possible due to inadequate personnel. It is the general practice in the various State health departments to maintain a division of laboratories and to have all laboratory analytical work on water supplies performed by this division. In a few instances, however, a water laboratory is maintained as a part of the division of sanitary engineering.

The general conclusion from a study of the information furnished to your committee is that in most instances the divisions of sanitary engineering of the State health departments are inadequately manned to perform the duties which logically should rest upon such divisions. Additional personnel is necessary to provide adequate water supply control, to say nothing of the other important functions of such divisions. Judging from the replies received to its inquiries, your committee is of the opinion that it will be beneficial to list the activities which are considered necessary in providing comprehensive and effective control of water supplies by a State health department. Your committee recognizes that many members of this conference are fully informed regarding the phases of water supply control work which are necessary or desirable, and hopes that it may be pardoned for presenting more or less elementary principles. It is the judgment of the committee, however, that this presentation will be of assistance to many State health departments in coordinating water supply control work and in extending and enlarging the functions of the divisions of sanitary engineering.

RECOMMENDED ACTIVITIES OF STATE HEALTH DEPARTMENTS IN CONTROL OF WATER SUPPLIES.

The completeness and effectiveness of control of water supplies by a State health department may be measured by the reduction in typhoid fever death rates. Complete and effective control will not only prevent recognized epidemics of typhoid fever but will accomplish a steady reduction in the number of scattered cases of the disease. The latter result will, in fact, ordinarily produce a greater reduction in rates than the reduction due to prevention of epidemics.

It is, therefore, the judgment of your committee that complete and effective control of water supplies should be provided in every State, regardless of other duties imposed upon the division of sanitary engineering. Complete control of water supplies used by the people of a State demands recognition of (1) the public water supplies, those serving municipalities, districts, and communities; (2) quasi-public water supplies, those serving institutions, schools, factories, and other public and quasi-public buildings, and places used for the assemblage or employment of persons, and (3) private sources of water supply installed for the use of individual families. Bottled waters used for drinking, beverage, and medicinal purposes should be considered as quasi-public water supplies.

Following is an outline of the activities which your committee recommends to provide for effective control of water supplies by the State health department:

1. Approval of proposed public and quasi-public water supplies by State health department.

(*a*) Approval of the source of supply and the plans for its development, including its purification.

(*b*) Approval of the installation after it is completed and ready for use. (This is to insure that the work has been performed in accordance with the approved plans.)

2. Supervision of existing public and quasi-public water supplies by State health department.

(*a*) Inspections by the State health department to cover the following features:

(1) Adequacy of the supply.

(2) Possibility of contamination of source.

(3) Possibility of contamination due to improper development.

(4) Possibility of contamination due to inefficient purification works.

(5) Possibility of contamination in distribution—for example, by cross-connections, unsafe reservoirs, etc.

(6) Possibility of contamination due to emergency supply.

(7) Sanitary quality determined by analyses made in the field and in the department laboratory.

(8) Extent of use of the supply and for what purposes.

(*b*) Submission of reports to State health department by local officials.

(1) Reports on operation of water purification plants.

(2) Reports of regular analyses of water supply made in laboratories other than that of the State health department.

(3) Plans and records of existing works when required by the State health department.

(*c*) Issuance and enforcement of orders and regulations by State health department.

(1) Requiring proper general maintenance of system, such as flushing of mains, cleaning of reservoirs and standpipes, removal of cross connections, etc.

(2) Requiring proper supervision, analytical control, and operation of water purification plants.

(3) Requiring abandonment of emergency intakes and pending such abandonment, requiring proper control of the use of the same.

(4) Requiring improvements to correct unsafe development of the supply, such as open well tops, leaky and unprotected reservoirs, leaky gravity lines, etc.

(5) Requiring abandonment of water supplies found to be impure and dangerous to health, and the installation of a satisfactory supply or a water-purification plant.

3. Investigation by the State health department of the necessity of public water supply systems in municipalities and districts not provided with a public water supply. Based upon such investigations local officials should be urged to provide satisfactory public water supply improvements.

4. Effective control of water supplies demands control by the State health department of sewerage, sewage disposal, and industrial wastes disposal. Such control should include approval or disapproval of proposed projects and enforcement of orders requiring improvements necessary to correct and prevent contamination of water supplies. This phase of work is wholly distinct from control of sewerage and disposal of sewage and industrial wastes for the purpose of preventing stream pollution and nuisances.

5. Application by the State health department of remedial measures to suppress water-borne typhoid fever epidemics.

6. Examination and approval by the State health department of water supplies for drinking and culinary purposes for common carriers. This work is to be carried on in cooperation with the United States Public Health Service.

7. Attention to private water supplies by the State health department is necessary, but the direct control of such supplies should be practiced by the local health officials. They should examine them and order their abandonment or improvement when necessary. It is the proper function of the State health department to furnish general information regarding the proper location and development of private water supplies and your committee advises that this may be best accomplished through bulletins. The State health department should also actively urge the abandonment of private water supplies when a public water supply of satisfactory quality is available.

The placing in effect of all of the above-listed activities can not be accomplished at one time and without great effort. In most cases it will be found necessary to select the most important activities to be undertaken first and to be followed by the addition of those activities which are considered to be of lesser importance. The enactment of basic legislation and the adoption of regulations are primarily required. In addition, adequate funds and competent personnel are necessary. In any case it is advisable that a program of development be adopted which will ultimately result in undertaking all of the activities recommended.

A motion was made, seconded, and approved that the above report be accepted by the conference as a progress report.

Prof. George C. Whipple of Harvard Engineering School presented the following paper:

STATE SANITATION.

State sanitation is so rapidly becoming a feature of our American Government, and the zest for health measures is becoming so great, that a consideration of certain fundamental principles by this conference of sanitary engineers should be not only appropriate but profitable. I therefore take the liberty of calling attention to some of the governmental principles which, though generally accepted, are often overlooked, and of expressing my personal opinion on certain matters of administration about which different views are held by different classes of people and in different parts of the country. What I have written is taken largely from a course of lectures on municipal engineering administration which I have given for several years at Harvard University.

HEALTH AND COMFORT OF THE PEOPLE.

By State sanitation is meant the efforts which State governments exert to prevent insanitary or uncleanly conditions of human environment which tend to impair the health or which are prejudicial to the comfort of the people. It is important, in the first place, to link these two terms together—the health and comfort of the people—for sanitation is concerned with them both. The two words are bound together in laws and legal decisions, as well as in common parlance. Nuisances are infringements against comfort as well as against health. Health, in its broadest sense, is something more than the absence of disease; it has a positive side. We measure health inversely in terms of sickness and death; we are beginning to attempt to measure health in terms of physical efficiency, capacity to work, and ability to enjoy life. The latter belong on the front side of the shield; sickness and death are for the back side. Both sides of the shield should be guarded.

Comfort has to do with the senses. Human discomfort is hard to measure, especially as people differ as to their sense reactions under different environments. These sense reactions are an important part of life; and the courts are sound when they decide that insanitary conditions are " prejudicial to health," even though the sense reaction may be merely that of a disagreeable odor. Bad odors from faulty plumbing or from badly ventilated rooms, bad odors in water supplies, bad odors from industrial plants, excessive noise, smoke in the atmosphere, oil deposits along the banks of streams and shores, and many other sense-offending conditions may be public nuisances and are properly included within the legal scope of "health and comfort of the people." I believe that sanitary engineers, who by their training are inclined to think in mathematical terms and have a penchant for measuring sanitation in terms of death rates, need particularly to be reminded of this aspect of sanitation.

POLICE POWER AND PUBLIC BENEFIT.

The police power is one of the inherent powers of government, that of protecting the people from dangers from within. Under it the Government may coerce the individual, take away his liberty, his property, and even his life, if necessary, in order to safeguard the safety, health, or morals of the people. Since the time of Magna Charta the English-speaking race has been preserved from tyrannous oppression, from undue exercise of the police power, by what is called "due process of law."

In the United States the police power originates in the State. It is exercised directly by the legislature, as representing the people. It may be delegated to some State department or official, to some city or city department, or to the National Government. Fundamentally, however, authority to act under the police power must be traced back to the State government.

Another function of government is that of doing for the people those things which the Government can do better, more cheaply, or more expeditiously than the people can do for themselves. These are acts for the public benefit, acts of public service, acts for the common good. They are paid for under the taxing power of government, another of its well-established functions. In recent years this idea of government has been greatly extended. Carried to the limit, it becomes paternalism or socialism. Many think it has been carried too far even in matters of health and comfort, and I am in sympathy with this view.

The two ideas of force and service represent the masculine and feminine elements of government. The best government results from a proper combination of the two. State boards of health, or departments of health as they are coming to be called, are concerned with both of these parts of government—health service and police power in behalf of health.

FUNCTIONS OF STATE HEALTH DEPARTMENTS.

State boards of health perform several functions. One of these is quasi-legislative in character, carried on under authority delegated by the legislature. A State board of health may be authorized to prepare a sanitary code, plumbing regulations, rules for the protection of water supplies, rules for reporting diseases dangerous to the public health, and the like. This is done because, in technical matters and in special fields where expert knowledge is needed, the legislature, composed of persons of varied attainments elected by the people, is less competent to enact such detailed legislation than a body of men selected for the special work at hand. For the best result, this delegated authority should be given to a body of men rather than to an individual. A health commissioner acting alone should not be allowed to perform functions which are legislative in character. Legislatures do well, however, to delegate authority for the preparation of rules and regulations which are essentially technical and scientific to competent boards rather than attempt to legislate directly.

A State board of health may act in a semijudicial capacity. This authority is seen in the matter of nuisances. The board may sit as a court, hold hearings, take testimony, and render decisions. Sometimes it sits as a court of appeal. In matters of this kind a board is better than an individual, as the decisions must often be based on facts and common judgment rather than on technicalities of science or law; that is, the board is a sort of judge and jury combined.

Of course there is much work of an executive character to be done by a State department of health. Some of this is incidental to the exercise of the police power—such as laboratory work, engineering, or inspection in connection with the oversight of water supplies, stream pollution, sewage disposal, nuisances, food sanitation, sophistication of food and drugs, statistical records of sickness and death.

In addition to these regulative functions much other work of quite a different character is done; vaccines and antitoxins are made and distributed; bacteriological diagnoses of certain diseases are made; nursing services are supervised; educational activities of various sorts are carried on. These works, done chiefly for the public benefit, are largely responsible for the increasing appropriations made to State departments of health. Further expansions of efforts of this nature are being considered in some States, such as maternity benefits, dental clinics, public health nursing, and the like. In my judgment, the wisdom of extending these activities is open to grave doubt. It is not at all certain that a State department of health is the organization best fitted to conduct popular education in health matters. It is certainly not the best organization to manage State hospitals and institutions. It is doubtful whether any form of activity which involves the operation of public utilities should be conducted by a State department of health. The attempt to combine the exercise of police power and the conduct of utilities for the public benefit involves administrative problems of serious character. In my opinion welfare work and public health work should be kept apart. Welfare work is done under the taxing power of government. Taxation for this purpose should be definite. If people want it or need it, let them appropriate money for it, knowing for what the money is to be spent. Let it not be confused in the public mind with money appropriated for the ordinary and well-understood police-power functions of health departments. In my opinion the time is coming when appropriations for all governmental purposes must be greatly decreased, and when that time comes it will be important to discriminate between those governmental functions which prevent injury and those which are for the public benefit. If it comes to a choice the latter should be sacrificed first.

There is another very important function of a State department of health which needs consideration, and that is its advisory power. This is a semi-judicial matter. Often the remedy for difficulties between contending parties is advice, not legal action. In all sorts of sanitary matters, in problems of water purification and sewage treatment, in matters of nuisances from offensive trades, a letter of advice from a State department of health which has established its reputation for fairness is often as effective as a legal order. In no way can State departments of health do more to improve sanitation than by improving the quality of their advice. Better advice and less drastic police action is, I believe, good policy; for more offenses against sanitation are due to ignorance of what to do than to willful disregard of law.

Akin to giving advice in particular matters is the setting up of standards of sanitation, of methods of procedure in all sorts of public-health activities. Any such standard should be carefully worked out, chiefly with reference to local conditions applicable within the State, but also with due regard to interstate and national relations. Standard rules and regulations are useful in two ways; they promote unity, and thus simplify administration; and they tend to raise the level of administration in communities hitherto backward up to that of the standard. Standards also carry with them two dangerous tendencies; they are liable to stifle progress by making people content with the standard, and they tend to destroy local initiative and self-confidence by causing cities and towns to fall back on the State. Standards tend to destroy initiative in those who make as well as in those who follow them. I believe that the standard methods of water analysis of the American Public Health Association have been highly serviceable in raising the level of water analysis in many laboratories; but I am also convinced that they have had a bad effect on the teaching of this branch of science, students and even instructors unconsciously getting the idea that the facile use of the standard methods represents the *summum* *bonum* of the art. In such a matter as plumbing regulations, uniformity throughout the State is desirable in the interest of convenience and economy; yet some municipalities prefer to make, as well as to enforce, their regulations, and it is difficult to decide whether in this matter uniformity is more important than local initiative. The special plumbing board appointed by the State Health Commissioner of Massachusetts is attempting to solve the problem by making certain minimum requirements State-wide and compulsory, and by setting up in addition standard detailed rules, which shall be optional for each city or town to adopt or modify. This seems to be a logical plan, as it means using the police power on a State-wide basis to prevent injury to health, and using only the advisory power in matters which relate chiefly to public benefit.

There is still another function of a State department of health which interlocks with all of the others, namely, that of inquiry, of investigation, of survey. Facts must be obtained as a basis of legislative action, judicial action, or advice, and the collection and preservation of these facts is of great importance not only to the department but to the community. The best method of preservation is by publication in annual reports. Interest in popular education in health matters has tended to turn the official reports of health departments into agents of propaganda. This is a mistake. Statistics make dry reading, but these records of facts should nevertheless form the backbone of annual reports. They are absolutely essential as a measure of progress. It is poor economy to eliminate them, because if not published they become unavailable in later years—and perhaps lost—thereby making new and expensive compilation necessary. Decisions as to what should appear in annual reports should not be left to officials who view the matter from the standpoint of printing and who have no expert knowledge of the value of the data presented for publication.

ENGINEERING DEPARTMENT.

The great shift of population from rural to urban conditions which has taken place in recent years has made the problems of public water supply and sewerage greater than ever before. The protection of water supplies against infection and the safeguarding of streams, lakes, and harbors against pollution involve engineering problems of a high order. These problems usually extend beyond municipal boundaries, and the State is the proper authority to cope with them. This is acknowledged by everybody, although it must not be forgotten that there are also interstate water pollution problems which must some day be taken up by the National Government or by river district commissions which override State lines.

A great question of administration arises in connection with these engineering matters. Ought they to be consigned to the State department of health, to the State engineer's department, if there is one, or to the water-supply commission, if there is one? Inland waters are used for public water supplies, drainage, power, recreation, fishing, and, in some instances, for irrigation and navigation. Conservation of all inland waters is of vital importance, and all of these uses must be given due consideration. It seems to me that the highest use of inland waters and the one which needs greatest consideration is that of public water supply. Drainage and water-power stand next, sometimes one, sometimes the other. The control of inland waters for water supply and drainage is an exercise of the police power in the interest of public health, and it seems to me that the control should be vested in that branch of the State government in which the police power is clearly recognized as a major function, namely, the State department of health. Water-supply commissions and State engineering departments are organized primarily to bring about public benefits, not to prevent damage being done. If the police power is exercised by them at all, it concerns safety rather than health. There is room, perhaps, for water-supply commissions in some States to appraise the water resources and to look after the uses of inland waters from the standpoint of public benefit; but to State departments of health should be given the oversight and care of the inland waters from the sanitary point of view, and this control should be recognized as paramount to all others. Hence, State boards of health need engineering departments. Most State boards of health have such departments to-day.

Besides water-supply and sewerage problems, there are other engineering matters which arise in connection with public health administration, such as problems of land drainage, of nuisances from trade waste, refuse disposal, plumbing, ventilation, rat-proofing of buildings, besides many minor engineering problems of rural sanitation. New York State has recently shifted its engineering department from the department of health to the State engineer's department. This is a regrettable action, as it takes away from the department charged with protecting the public health its strong right arm and reduces the engineering work involved in the sanitary protection of the waters to a subsidiary place in a department interested primarily in doing things for the public benefit and not acting under the police power. I hope that no other State will follow this unfortunate lapse from sound governmental principles which New York has made.

The supervision of water supplies and sewage-disposal works calls for chemical and biological as well as engineering work. These three sciences should be closely allied. Laboratory work is also required for other departments than that of engineering. The question arises, therefore, should the water and sewage laboratory be a part of the engineering department, or should all of the laboratory work be combined in a general laboratory in the interest of a unified equipment and of economical operation?

My experience in both the laboratory and administrative side has convinced me that there is little if anything, to be gained by consolidating laboratories in one department, although the physical concentration of the laboratories in one place may be a convenience and a slight economy. It is not often realized how widely and in what vital respects laboratories differ from each other. To be sure, gas and electricity and test tubes and balances are used in them all, but the work done in a laboratory of water analysis is as different from that done in a food and drug laboratory or a bacteriological diagnosis laboratory as the work of the electrical engineer is different from that of the sanitary engineer. The modern sanitary engineer, however, is trained to use the microscope and the balance as well as the transit and the level. To be of the greatest use to the sanitary engineering department the laboratory of water analysis should be a part of this department and separate in its personnel from all other laboratories. One reason for this is that more and more the importance of having water analysis conducted as field work rather than laboratory work is being appreciated. In the future the laboratories of sanitary engineering departments may be very largely headquarters for field parties who do their principal work in the field in connection with inspections. The laboratory as a tool should be always ready, quickly responsive, and the results should be available as soon as the analyses are completed. There should be no circumlocution in reporting, and the record files should be so kept as to be accessible at all times.

As to organization, my preference is for an engineering department in a State board of health, which has as its head a sanitary engineer who reports to the chief executive and who has under him an assistant engineer, a chemist, and a biologist, with such assistants for each as may be necessary. In a small department the chemical and biological work may be done by one man. In a large department one man specially trained in chemistry and another specially trained in biology are needed; but each should know the whole range of ordinary water analyses, chemical and biological, and each should be competent to act as director of the laboratory, this matter being governed by seniority. The special attainments in chemistry and biology are needed because of the unusual problems which are continually coming up for solution and in order that research may be carried on in the best way. While different forms of organization are to be expected in States which differ in size, condition, and tradition, one principle should always govern, and that is that the sanitary engineering department should have the engineering, chemical, and biological talent closely interlocked.

PERMITS, APPROVALS, ORDERS, ADVICE, AND RECOMMENDATIONS.

The object of the sanitary engineering department is to conduct such investigations and provide such information that the State board (or department) of health may act as may be necessary to maintain and improve the cleanliness of the environment of the people. The two subjects which loom largest in the work are public water supplies and sewerage systems, with their accompanying problems of stream pollution, sewage treatment, and water purification. It is right and proper that State departments should supervise these matters; but in considering what action should be taken the two ideas of police power and public benefit must be kept clearly in mind.

In employing the police power, practice has developed several methods which demand comment. One method is that of permit. The State law may prescribe that no sewer may be built to discharge into a stream unless a permit has been received from the State department of health. This implies that there must be a subsequent inspection to make sure that the rule has been complied with. The object of the law is to prevent an injury. In plumbing, the system of permit and inspection is very common. The method is applied especially to matters in which the proscription is definite or of a routine character. It requires little special ability to carry out this method, as the rules are usually definite and infractions obvious.

Another method is that of approval. The State law may say that before works for a public water supply are constructed the plans must be approved by the State department of health. This action demands an investigation of the particular circumstances which exist. Approval is more than permission: it implies that the plan proposed will accomplish what is intended; that it is reasonably satisfactory. Those who exercise this power of approval should realize. however, that it is an act done under the police power, and that the object of police power is to prevent public injury, not to confer a benefit. While in common usage the word "approval" carries with it the idea of commendation, legally used in connection with the police power it does not commend. The approval of a plan really means that the plan is not disapproved; that it contains no serious fault; that it "gets by." The plan may not be the best plan, yet if it will reasonably serve its purpose of preventing a public injury to health, safety, morals, or the like, it may not be disapproved under the police power of the State. Approval may also carry with it the idea of necessity. For example, in Massachusetts the taking of land to protect a public water supply must be approved by the State department of public health, the idea being that the taking should not be made unless it is necessary for the protection of the public health. There may be other special cases of approval committed to the State department of health by the legislature, but what I am emphasizing here is the fundamental idea. In geometry we learned that certain procedures were "necessary and sufficient" to prove a given theorem. Those who have to approve sanitary engineering works would do well to keep these two words in mind.

Legal approval does not necessarily carry with it the idea of general commendation, and it is somewhat unfortunate that popular usage tends to make people read this idea into the word. The owner of some proprietary device, which has been approved for a special situation, likes to advertise his device by saying, "It has received the approval of the State board of health," and the public gets the idea that the board has given the device general commendation. For this reason letters of approval should be written with great care and with reference to possible misuse. In my opinion it is perfectly consistent for a State department of health to give approval to one plan and then proceed to advise a better one, or to reply to the applicant that approval to the plan will be given on a second request, but will be withheld pending the consideration of another suggested plan, which is deemed a better one.

We have next to consider the question of "orders" of the board of health. Here we recognize action under the police power in a drastic form. The State board of health orders that a certain thing be done in the interest of the public health. A city may be ordered to install a water purification plant or a sewage treatment works, or a manufacturer may be ordered to install devices for preventing the spread of nauseous fumes. It is necessary to be very careful in these matters not to exceed authority, not to be unjust, and not to be unduly arbitrary. It is sometimes difficult to discriminate between what is merely desirable and what is necessary. It must be remembered that the police power is not intended to bring to pass what is desirable—it is confined to what is necessary to prevent injury. Orders must be given with reference to the ability of their being carried out. There have been instances where a State board of health has ordered a municipality to install sewage treatment works, to do which would have involved borrowing money beyond the legal debt limit. Such an order is inconsistent with good government, to say the least, and is sure to raise legal complications.

Orders should be directed against the injurious result, placing the responsibility for the remedy upon the person or city causing the public injury. An order to cease committing a nuisance may be properly accompanied by advice as to how to stop the nuisance, but the latter must be regarded as advice only and there must be no implication that following the advice will relieve the wrongdoer of responsibility.

For example, it is a desirable thing for a city house to have a connection with the sewer in the street; but (unless there has been legislation to the contrary) the local board of health can not compel the house owner to make this sewer connection unless his method of disposing of the house sewage is in some way prejudicial to the public health, safety, morals, or the like. The responsibility is on the individual to abate the nuisance.

In the same way the treatment of the sewage of a city may be desirable on general sanitary principles, but (in the absence of definite legislation) the State can not compel the city to put in a disposal plant unless the existing method of disposal is doing, or is reasonably certain to do, a public injury. Even then the State should not attempt to order in detail the method of treatment, although it may order the nuisance to cease, and advise as to the best method.

In emergencies, of course, boards of health have, and ought to have, summary powers. They may have to act without legislation in the interest of preserving the health of the people. Such powers should be limited, however, to emergencies and should not be stretched too far. It is better that a community endure temporary injury than that the principles of good government be overruled.

With these conceptions of approval of plans and orders for abating nuisances, we see the important part which advice can and should play in sanitary administration. The benefits of advice depend upon the reputation which departments of health have for giving sound advice. Letters of advice should be brief, clear, and definite. They should be sent as soon as possible after the necessary information has been secured. This virtue of promptness has been sadly neglected in many States. Unless advice is backed up by reputation, it is likely not to be followed. This means that the sanitary engineer of a State should be competent, experienced, and trustworthy, a man of good judgment and abreast of the times in sanitary science. It means that his department must be well equipped to gather and preserve the necessary facts, and equipped to conduct such investigations and carry on such experimental work as may be required to give proper advice. As a result of my experience as a practicing engineer, as a public-health administrator, and as a historian of the Massachusetts State Board of Health, I am convinced that the advisory functions of a State department of health carry with them more power for bettering sanitary conditions than the more drastic actions covered by permits, approvals, and orders, although without the latter the advisory powers would lack force.

A recommendation is crystallized advice. It usually relates definitely to some policy or line of action. Unlike approval, a recommendation carries with it the idea of commendation.

I believe that there is a mistaken tendency in some States, and especially among some of the younger and less experienced officials, to exert too much authority, to try to accomplish results too quickly, to force communities to do things for benefit rather than to avoid injury, and to emphasize sanitation at the expense of other things just as important. Sanitation is not the *summum bonum* of life; it is a means to that end. If sanitation is forced much beyond the willingness of the community to support it, reaction is almost certain to follow. On the other hand, State health officials should avoid the opposite extreme very well illustrated by one of Hambone's Philosophical Meditations: "Parson tells me ah ort to be patient; but when ah tries to be patient, ah goes to sleep." State sanitary engineers must not sleep at their post—and I would like to add that I know of no class of men less likely to sleep at their posts than engineers.

THE SANITARY ENGINEER.

Finally we come to the sanitary engineer himself. Originally, and in its narrower sense, this term was applied to engineers who had to do with sewers and drains. Plumbers still style themselves sanitary engineers and have a national association of that name. But the field has expanded and now includes not only sewers, but sewage treatment, water purification, and the like. It embraces other cleansing operations such as street cleaning and refuse disposal. The sanitary engineer of to-day must have a knowledge of biology and chemistry as well as hydraulics and the art of building; he must be familiar with laboratory procedures; he must understand the relation between sanitary works and the public health and between the cost of works and sanitary value. It has been suggested that such a man should be called a public health engineer. This is certainly an appropriate title for engineers in a public health department; nevertheless, it is merely a translation of sanitary engineer, and it does not seem to be worth while to multiply names and titles without adequate reason. In fact, I sometimes think it would be just as well if sanitary engineers were known merely as civil engineers, or even as engineers, just as public health officers are known as doctors. Personally I should regard the title of "Engineer Smith" as equal in honor, dignity, and importance to that of "Doctor Smith," assuming of course that the title "Engineer" represents an engineering degree, membership in a national professional society, or some other adequate standard of attainment.

From my experience, I believe that in a State health department the work of the sanitary engineer is of importance equal to that of the doctor of medicine. I can say this with perfect frankness, because no one has been more earnest than I have been in teaching biology to engineers, in securing cooperation between engineers and doctors in public health work, and in establishing schools of public health in which hygiene, preventive medicine, engineering, statistics, and administration shall be properly blended. In health department organizations engineers and physicians should be given equal standing, equal salaries, and equal ratings as to seniority, bearing in mind certain differences between administrative and executive work. The United States Government, through its Public Health Service and the Medical Departments of the Army and Navy, would do well to set an example in this matter. The lack of recognition of equality is one of the reasons why some of our best young engineers hesitate to enter the Public Health Service to-day.

I believe that the executive positions in health departments should be under the civil service (perhaps I ought to say under a reformed civil service), and that there should be provision for retirement on pension at a certain age or after so many years of service. In consideration of this feature, the salaries paid should be somewhat lower than those paid for work of similar grade in private practice. Just as business men make more money but take greater risks, so engineers in private practice should make larger incomes while subjecting themselves more to the ups and downs of business conditions.

The great bugbear of public positions to-day is political interference. This is steadily causing a depreciation in the character of engineering service in cities and States alike. Civil service has not been an unqualified success. It has tended to keep out the unfit, but it has not increased the excellence of the service. It has made it difficult to get rid of men who are lazy, of mediocre ability, or of unpleasing personality, and pleasing personality is a quality very essential to teamwork in a public department. Reform in civil service is highly essential, if our health departments are to be placed on a high plane. There is another angle to the matter. If it is not right for legislators to interfere with the personnel of the executive departments, it is equally bad for the latter to interfere with legislative matters. Unfortunately, there are too many examples of this practice.

More than all else it is important that engineers pay greater attention to their own ability. The young graduate of an engineering school is a fledgling; he can fly a little, but not far or well. He needs practice; he needs contact with engineering problems; he needs much study. The engineer must study throughout his life. Self-made engineers, like the engineers of the past, developed habits of study which never left them. College graduates too often think that their studies are over when they are graduated. When an engineer retires for age he may cease studying, but not until then. William Mulholland, the self-made engineer who built the great Los Angeles Aqueduct, told me recently that he takes 15 magazines and reads them. Sanitary engineers must read much, because their field is wide and embraces many sciences.

In States where appropriations are limited, the attempt to get proper men for the position of sanitary engineer is met in various ways. One way is to employ an engineer on half time, allowing him to engage in private practice. This I believe to be a thoroughly iniquitous arrangement, unless the engineer conscientiously refuses to do any private work whatsoever within the limits of the State. Even then the arrangement is not altogether satisfactory, because it is difficult for the engineer to be on hand at the right time. Another method is to employ an engineer on half time, letting him combine State work with teaching. This is less objectionable, but not altogether satisfactory. A full-time sanitary engineer is as much needed as a full-time health officer. The job is big enough for a whole man and for the best man obtainable. In my opinion, it is better to obtain a lower priced full-time man than a higher priced half-time man. The appointee then has a definite piece of work for which he is personally responsible. This responsibility tends to make him do his best; whereas if he is carrying on two jobs at the same time, there is danger that he may slight both of them, unless he is a man of exceptional ability and force of character.

Even if a sanitary engineer gives what is practically his whole time to a State department of health, he should not allow himself to engage in private practice within the State, for sooner or later he is sure to find himself in a situation which will seriously compromise his reputation. He may, however, accept occasional consulting engagements outside of the State without overstepping the limits of professional etiquette. Professional ethics among engineers is something to be cultivated and guarded with jealous care. Licensing of engineers by the State or the setting up of any artificial standards will never accomplish for the profession what the engineers can do for themselves if they will.

There seems to be one solution of this problem which nowadays is seldom tried, namely, to reinforce the official sanitary engineer with a consulting engineer who is either regularly retained or called upon for advice in particular cases. The Massachusetts State Board of Health had this practice at one time, and some of our most eminent engineers, chemists, and biologists have served the State in a consulting capacity. This practice, in my opinion, should be renewed and extended. It would have several advantages. In the first place, it would greatly strengthen the reputation of the State department of health and give its letters of advice greater weight. It would make it possible for the smaller States to have as good advice as the larger States. In case of controversies it would strengthen the State in its contentions. It would tend to soften one of the sharp corners which result from laws requiring plans to be approved. At the present time it so happens that many of the engineers engaged in private practice are older and more competent than the State engineer who must pass upon the plans submitted. The less experienced State engineer may, however, understand local conditions better than the designing engineer who has made the plans. Under these conditions, refusal to approve the plans creates a situation disagreeable to both parties. If, however, the State department of health had a consulting engineer, doubtful plans could be approved or disapproved with better grace and a greater feeling of security that the proper result had been reached.

There is also a present-day tendency for engineers in high positions to do too much work by proxy. Accustomed to assistants, they have stenographers to write their letters and young engineers to make their computations. Many of our modern methods, thought to be so efficient, are not so, because they are turning our chief engineers into routine executives and are confusing administrative and executive work. Our chief engineers and consulting engineers ought to do more personal engineering work and leave more of the routine work to others. Engineers who cease to make personal studies run downhill rapidly.

Engineers who enter the public service under present conditions do so at a personal sacrifice. I believe that public service ought to involve personal sacrifice. Young men entering the service should understand this clearly. The sacrifice is recognized in times of war; it should be recognized in times of peace. Public service means doing for others. It is only by the recognition of this principle that our health departments will be filled with the right kind of men—men who are not there for gain, for large salaries, or easy work. Personally I know of no better way for a young man to serve his day and generation than to become an engineer, learn how to employ the great forces of nature for the use and convenience of man, and then enter the public service and spend his life for the public good. It does not mean wealth; it means hard work and many conflicts with the powers of evil. It may not always mean public recognition and honor; but it does mean much personal satisfaction and many pleasures by the way.

Mr. Sol Pincus presented the following report:

REPORT OF THE COMMITTEE ON CROSS CONNECTIONS, BY-PASSES, AND EMERGENCY INTAKES ON PUBLIC WATER SUPPLIES.

It must be recognized to-day that the problem of having safe water furnished for human consumption in cities in this country is now very generally, and almost entirely for the larger cities, a problem of protecting and insuring the freedom from contamination of the existing water supplies which are ordinarily found to be safe, and not so much the problem of making original installations or reconstructing water-supply plants. The water-supply question for American cities, taken as a whole, is reaching a new phase of development, as far as the assurance of the safety and health of the consumers is concerned; a phase where the regular protection and maintenance of the present standards of quality and safety are the foremost matters of concern.

The typhoid fever death rate of American cities has been steadily diminishing, so that to-day it is fully a tenth of what it was a generation ago. The average for the last few years for the larger cities of the country is not far from five per hundred thousand, which is a result largely attributable to improved water supplies. Entire States are now turning in typhoid death rates year after year below eight per hundred thousand, and in some few cases below five. For the State health department, where the general responsibility for the maintenance of such diminishing typhoid mortality rests, there is a most difficult challenge to be faced in insuring that the public water supplies will be so thoroughly safeguarded and the remotest possibility of infection of the supplies removed that the decline in typhoid fever deaths will not be halted or reversed. While some cities or sections of cities were being furnished with unsafe and contaminated water, there was always the certainty of progress to be achieved in the reduction of the typhoid fever rate by the improvement each year in one or more cities of the quality of the public water supply. Such reductions would oftentimes result even though there might occur a breakdown in an improved water supply. But as the case and death rate curves come lower and lower with passing years, a point will be reached where a single outbreak, even of a relatively small number of cases, will have a predominating and controlling effect on the State rate for the year. Such a point is fast being approached by many States, if it has not already been reached by certain few States. And with the approach of this condition, the proverb, "Eternal vigilance is the price of freedom," must become the ever-present guiding principle of control if freedom from water-borne disease is to be maintained. The supervision that is to maintain this almost complete freedom from the possibility of the infection of the water supply requires the steady, watchful, and thorough direction of a conservative and critical yet open-minded sanitarian, whose familiarity with the many-sided ways of possible water-supply contamination has not bred a contempt for the minor paths by which dangerous conditions can arise in the water supply.

In view of the present circumstances regarding the problem of the water supplies of most large American cities, where the public water supply is ordinarily good, it was felt by the members of the committee that increasingly greater consideration will have to be given to by-passes, emergency intakes, and the numerous cross connections which are frequently present. Attention to the use of these devices may soon have as great a significance in real disease reduction as will the improvement of the ordinary quality of water supplies. In the maintenance of safe public water supplies, there are no matters requiring more careful attention and capable of more baneful consequences than these, excepting only the daily operation of the purification processes.

The uncontrolled and unregulated use of cross connections, by-passes, and emergency intakes on water supplies seems to have been quite general until the last few years. Before 1910, little notice was taken of the presence and use of these devices, according to the State health reports of the States most active in water supply supervision. To-day, even in the majority of the States, the matter of the proper supervision and policy governing these devices, especially cross connections, is amazingly undeveloped and unformulated. Even the definite presence of cross connections, by-passes, and emergency intakes is generally unknown to the States or local departments. Such a situation is potent with most serious ill-consequences to the citizens of those places where investigations have not been made for determining the prevailing conditions regarding such devices and where the proper supervision has not been established.

It appears that the question of by-passes on public water supplies was the first of these devices regarding which action was taken by any of the States. As the satisfactory operation of water purification processes became more and more definitely achievable, it soon was obvious that by the existence of by-passes around any salient part of the purification scheme the value and reliability of the entire process was seriously vitiated. Through the power and authority to review and approve plans for new construction on water supply plants, the better equipped States have definitely shown their disapproval to all such by-passes and have required their elimination, at least from any plans for proposed water supply plants. There seemed to be no doubt in the minds of the members of the committee that all by-passes should be removed from water purification processes, except by-passes about primary sedimentation basins, aerators or mixing chambers. The basis for exempting by-passes around these features of the purification process was on the ground that in some installations these features were not a necessary step at all times in the purification process, nor were they of great sanitary significance at all times. The committee is of the opinion that there can scarcely be any objections to this principle and the exemptions specified.

The question regarding the most advisable State ruling on the installation of emergency intakes on public water supplies has been in some ways one of the most difficult and perplexing problems before the State health departments. The danger to the public health from the existence of such an intake whereby unsafe water could be sent into the public mains has been universally recognized. However, in frequent instances it was contended that compromise with the demands of full safety was necessary and that such intakes should be permitted on account of otherwise large fire hazards. In the very large cities, it was claimed that the risk of being without adequate quantity of water at any time overbalanced the health hazard. Both as sanitary engineers and as officials with a public responsibility, the committee could not acknowledge in principle the validity of these contentions. Though in some cases for a long time it may not be economically justifiable for a town or city to incur the indebtedness necessary to provide such an enlarged water supply installation as will make the emergency intake unnecessary, it is, however, asserted that no city can build for permanency in the present era if the health of all its citizens is endangered by the unguarded and ever present possibility of the infection of its public water supply. It is from that point of view that the committee has adopted the very positive principle on emergency intakes, that no emergency intake should be established or maintained in connection with a public water-supply system, a stand which has already been enforced by some of the States. The committee, however, has recognized that a modification of the principle may be necessary for present enforcement in the case of cities with inadequate water supplies, but such qualified enforcement has been considered only as a temporary measure.

The committee gave the greatest part of its discussions to the recommendation covering the question of cross connections on public water supplies, as this problem has been so prominently and urgently placed before the waterworks and public health officials in many of the States. Wide difference of opinion was found to prevail among the various States in what should be considered the proper policy for regulating cross connections. This divergence of view point was well represented on the committee, and it was only after very extended discussion, both personal and by correspondence, that an agreement was reached on this subject.

The cases of the use of cross connections were divided into two kinds. For the first group, the committee came to definite and prompt agreement, namely, that when an impure independent supply was maintained for ordinary industrial purposes, any cross connection with a public supply regradless of the devices that may be installed or the precautions that may be taken, would be an unsafe and altogether too dangerous procedure at any time.

For the second group, where a cross connection to a private fire protection system using impure water exists, but where no outlet of water is provided except through fire hydrant, sprinkler plug, or hose connection, a somewhat less hazardous situation was recognized. Though the demands for complete safety require that the water served for human consumption must at all times be free from danger and hence connection with impure supplies totally disapproved, the committee came to the opinion that account must be taken of the temporary use in some circumstances of cross connections with the most effectual safeguards possible. It was believed that such temporary permission by the State department of health in exceptional instances for the use of a cross connection for a fire protection service should never become a permanent provision, but after a sufficient period for the development of the public supply for adequate fire protection the permission would be revoked. An instance of such a course is evidenced by the city of Hartford. Here in 1909 some of the first installations of cross connections with factory mutual double check valves were made. After 10 years had elapsed an order was issued in 1920 giving the mills until September of this year, 1921, to completely sever all physical connections.[1] The committee has been convinced by the large number of instances of the contamination of the public supply through cross connections that such connections as a permanent measure should never be indorsed. The committee wishes especially to call attention to the many cases of pollution from such connections that are cited in Appendix No.

---

[1] The manager and chief engineer, Mr. C. M. Saville, of the Hartford water department, expressed his conviction as follows: "In the 10 years' experience of Hartford with 12 sets of check valves, the records show that eternal vigilance only can keep these valves even passably tight; that they do leak on the slightest provocation; that sometimes both valves have been found leaking at the same time; and that there is no assurance that they will remain tight even for a short period after test. The custom of inspection is a visit once each week to make pressure tests and once every four months for a thorough inspection of the entire valve." (Journal of American Public Health Association, September, 1920.)

4 to the final report on private fire protection service printed in the November, 1920, Journal of the American Water Works Association, and to those cited in the annual reports of the New York State Department of Health.

As regards the increased fire hazard from the elimination of cross connections, it is believed after the provision of what is generally accepted as adequate public fire protection service, as to quantity, pressure, and distribution, that no life hazard from fire can be justly charged to the public water supply system. In the instances where the loss of human lives occurred at fires, which are given as arguments for permanent cross connections, it has been found upon investigation that were adequate public water supplies available in all probability the loss of life would not have been prevented by the use of cross connections, but the deaths were due to flagrant violations of fundamental building principles regarding fire escapes, outlet doors, floors, wall thickness, fire-fighting equipment, etc.

DATA OBTAINED FROM QUESTIONNAIRE.

The number of States replying to the questionnaire were 30. Of these States only 15 could give positive figures on the number of public water supplies having by-passes, emergency intakes, or cross connections. Two States reported no cross connections, while several reported two or three, and three States reported 18 or more water supplies with cross connections. One State reported no bypass existed on any public water supply, while most of the States giving definite figures showed only a few water supplies, less than 10, which had by-passes. There was no State that reported a total absence of emergency intakes on the public water supplies, but five States each reported one emergency intake.

Regarding the regulation of cross connections there were three States which specifically regulated against any cross connection between a public and an unsafe water supply. Most of the States reporting attempt to control cross connections as well as by-passes and emergency intakes through the general State health department authority and through the power to review and reject plans for new installations and additions to water-supply plants.

Of the 30 States from which replies were received, 13 stated that any type of cross connection was opposed and would be disapproved. This number included the three States having a specific regulation against the maintenance of a cross connection. Nine States approved or permitted the use of cross connections when proper safeguards are provided. One State doubted the advisability of permitting the use of any cross connection, while another State did not approve any but believed the complete elimination of cross connections could not be enforced. Six States that replied gave no opinion in approval or disapproval regarding cross connections. It is a surprising thing that many of the nine States permitting or approving cross connections seemed to make no distinction in their policy between a cross connection joining the public water supply and a system for fire protection only, and a connection joining the public water supply to an unsafe private or industrial water supply.

Eleven States gave accounts of a total of 20 outbreaks of typhoid fever, dysentery, or gastro-enteritis, 11 of which were caused by cross connections, 4 due to by-passes, and 5 due to the use of emergency intakes. These reported examples of disease outbreaks known to have been caused by use of cross connections, by-passes, or emergency intakes are very largely incomplete, as numbers of instances of such outbreaks other than reported by the questionnaire replies are known to the committee members. In some of the reported outbreaks due to cross connections, a single check valve, in addition to a gate valve, had been provided. Only one instance was given where leakage had been detected through two check valves at the same time.

The complete replies to a previous questionnaire (regarding only cross connections) which had been circulated in 1918 were made available to the committee, and it is believed that the summary of the replies obtained then is worthy of present consideration. Thirty-three States and one Canadian Province sent replies to the questionnaire concerning the existence of specific regulations with respect to cross connections and the State's attitude regarding the use of such connections with double check valves. Replies to a similar questionnaire were also received from 10 of the largest American cities.

There were two States that had specific legislation regarding cross connections at that time, one permitting their installation under certain safeguards and the other requiring a notice to the public whenever a cross connection is used. Thirty-one States and one Province had no specific law or regulation relating to the installation or use of cross connections. Eighteen States approved or permitted a cross connection to be installed and maintained under certain provisions, while 12 States and one Province did not approve or permit, as far as possible, any cross connection whatever. Three States gave no definite or clear opinion.

The replies from the 10 large cities are especially noteworthy, for although only three had specific regulations or ordinances against the use of cross connections, they were all emphatically opposed and unanimously refused to permit any cross connection whatever with their public water supply.

CONCLUSIONS OF THE COMMITTEE ON CROSS CONNECTIONS, BY-PASSES, AND EMERGENCY INTAKES ON PUBLIC WATER SUPPLIES.

The committee on cross connections, by-passes, and emergency intakes on public water supplies, after several meetings and full consideration, recommends the adoption of the following definitions and principles:

A. CROSS CONNECTIONS.

Definition. A *cross connection* is a physical arrangement whereby a public water supply system is connected with another water supply system, either public or private, in such a manner that a flow of water into such public water supply system from such other water supply system is possible.

Principle No. 1. No *cross connections* should be established or maintained between the public water supply system and any other water supply system, private or public, unless both water supplies are of safe sanitary quality and both supplies and the connection thereof have received the approval of the State health department.

Principle No. 2. In cases where it is necessary or advisable to supplement an impure private water supply with the public water supply distributed in the same piping system, the public supply must be made available by delivering it into a cistern suction well or elevated tank, at an elevation above the high water line of such cistern, suction well, or tank.

RECOMMENDED MODIFICATIONS OF ABOVE PRINCIPLES FOR TEMPORARY APPLICATION UNDER EXCEPTIONAL CIRCUMSTANCES.

While the committee is of the opinion that full safety demands such complete separation of the public water supply system from other water supply systems delivering impure water, the committee recognizes the relative degree of safety which can be provided by suitable check valve installations on connections between a public water supply and a piping system used for fire protection only.

The committee is cognizant of the fact that such connections may be proper and reasonable under certain conditions, and desires to express the following requirements which should be met in making and maintaining such installations:

1. Such connections should not be permitted where the available public water supply or private fire protection supply is adequate for fire protection purposes.

2. That the fire protection piping system shall not be connected with any other piping system upon or within the property served, and that there shall be no outlet from such fire protection piping system except through sprinkler head, fire plugs, and hose connections. This requirement is intended to prevent a flow through check valves, except at times when a sprinkler head, fire plug, or hose connection is open.

3. The cross-connection shall be equipped with such devices as can most effectually prevent an inflow of water from the fire protection system to the public water supply system.

4. The committee is of the opinion that the most efficient and dependable device developed up to date (aside from the method described in principle No. 2 above) is the check valve installation recommended by the associated factory mutual fire insurance companies of Boston, Mass., consisting of two gate valves with indicator posts, two check valves of the factory mutual type, with drip cocks and gauges for testing, an alarm valve equipped with a recording pressure gauge, a by-pass meter around the alarm valve, all to be placed in a vault of water-tight constructions accessible to ready inspection.

5. A systematic test inspection of the cross connection, including periodic examination of the interior of the check valves by the department in charge of the public water-supply system, must be provided, without which inspections the installations of the cross connection would be a highly dangerous health menace. The inspection must therefore be made reliable, thorough, and responsible.

6. The committee views as a self-evident requirement that in every case where a cross connection is being considered for approval a thorough investigation will be made as to local conditions and as to the necessity and advisability of the cross connection, and that the local municipal officials will be made fully acquainted with the circumstances and given due opportunity for presenting their views.

B. By-Passes.

Definition: A *by-pass* is a physical arrangement whereby water may be diverted around any feature of a purification process of a public water supply.

Principle No. 1. No *by-pass* should be established or maintained whereby water may be diverted around any feature of a purification process of a public water-supply system, provided that with the specific approval of the State department of health *by-passes* may be permitted around primary sedimentation basins, aerators, or mixing chambers.

APPLICATION RECOMMENDED.

Where there are existing by-passes, except as provided above, the correction should be obtained by the complete removal of the by-passes or the removal of a section of the by-pass piping.

C. Emergency Intakes.

Definition: An *emergency intake* is an intake or other device capable of introducing water into the public water-supply system from a source of supply which, because of its unsafe characteristics, has not been approved for ordinary use by the State department of health.

Principle No. 1. No *emergency intake* should be established or maintained in connection with a public water-supply system.

APPLICATION RECOMMENDED.

Where emergency intakes are existing and where the regular water supply is adequate and the emergency intake can be safely removed, the emergency intake should be completely taken out so as to be unavailable for use.

Where the regular water-supply system is not adequate and the maintenance of an emergency intake is conclusively necessary, it is obvious that such intakes must be continued, but should be under the complete supervision of the State department of health, so that the intakes will not be used except under conditions constituting an emergency. During the continuance of the emergency intake, the State department of health should make every effort to obtain the enlargement of the existing water supply plant, so that the emergency intake may be removed at the earliest possible time.

For the maintenance of an emergency intake, under the above-mentioned circumstances, the following safeguards should be adopted and enforced:

1. (*a*) The water-tightness of the valve on the emergency intake connection should be tested and the valve sealed by the State department of health or (*b*) the valve should be sealed and a section of the intake piping should be removed, making it necessary to replace the pipe section before the intake is available.

2. Provision must be made for the chlorination of any water taken through the emergency intake before delivery is possible to the distribution system.

3. Whenever it becomes necessary to open the emergency intake, the waterworks official must give immediate notice, if at all possible, preliminary to the opening of the intake, to the public affected and to the State and local health officials. The disinfection equipment should be placed in service immediately, and a warning given to boil all water used for drinking and domestic purposes. Such warning should be continued until the emergency intake is again closed and sealed, and the water supply system cleansed and declared safe by the State health department.

A motion was made by Mr. J. F. Jackson, Connecticut, seconded by Mr. E. S. Tisdale, West Virginia, to have the report adopted and printed as the action of the conference, and copies sent to the various State sanitary engineering divisions and to the fire underwriters associations. The motion was adopted.

Mr. J. I. Connolly presented the following paper:

EPIDEMICS FROM STEAMBOAT WATER SUPPLIES.

A public health problem that has thus far remained unsolved, even though it is ofttimes of very great importance, is the prevention of epidemics of disease caused by unsafe water supplies on vessels. Numerous epidemics in the past have been attributed by common opinion to such causes, and a few have been carefully investigated and the source of the infection proven to be the use, for drinking purposes, of contaminated water supplies on shipboard.

The continued existence of these dangers to the public health is both a disgrace to our civilization and a challenge to our health authorities, both State and National, to strike at the root of the evil and forever eradicate it. Such a task is not one to be lightly essayed, in view of the many difficulties to be surmounted. The seriousness of the problem is more apparent when we consider the large proportion of cases among those who might be exposed, compared with most epidemics of water-borne diseases from other sources. In a number of instances, particularly those where epidemics originated from the use of contaminated drinking water on excursion steamers, as many as 60 per cent of all the passengers were made ill. When the passengers are changed every day or so the large number that may be exposed can scarcely be realized.

Thus, for instance, a serious epidemic was traced last year to an excursion steamer on the Mississippi River, which carried 98,000 passengers during the four or five summer months that it was in operation. Another excursion steamer, to which another equally serious epidemic was traced in the summer of 1920, is operated the year around, traveling the whole length of the Mississippi from St. Paul, Minn., in the summer time, to New Orleans in the winter, and carries in the neighborhood of 200,000 passengers during the year. It is estimated that 16,000,000 passengers are carried annually on the Great Lakes vessels alone, of which about 9,000,000 are ferry passengers who use no drinking water.

But the ill effects are not confined simply to the large numbers infected on the boats, for the germs are carried in the bodies of the victims the whole length and breadth of this great land, to start innumerable new foci of infection wherever they may go. Therefore the problem is one which interests not only the cities and States on the waterways, which naturally feel the most severe and immediate result of such epidemics, but also every city, town, and village to which a traveler might come, bearing in his body the seeds of disease, poverty, and death.

The magnitude of the problem consists, not alone in the number of vessels and passengers concerned and the extent to which the effects of epidemics may ramify to the farthest corner of our country, but also in the difficulty experienced in securing the substitution of safe water supplies for the dangerous ones responsible for these epidemics. The fact that the boats are sailing upon water makes the temptation to procure drinking water from directly overboard through the sea cocks of the vessel one not always easy to resist. The surprising ignorance and almost criminal apathy in regard to sanitary requirements displayed by the crews of vessels is often the cause of trouble, as this indifference leads to the misuse or the failure to use the safeguards for the water supply that may be provided. It may sound unbelievable to those accustomed to dealing in sanitary matters, but I can assure you that the engineer having charge of the purification of Mississippi River water for drinking purposes on one of the vessels causing epidemics last year told me that water purified itself naturally in flowing a distance of 60 feet, so that untreated river water taken 60 feet below a sewer outlet was perfectly safe to drink, and that he himself always drank untreated river water. Certainly the water he was furnishing to the passengers showed that he was putting his theories regarding the uselessness of purification into practice. When he started working on the river, he had had various stomach and intestinal disorders, he admitted upon further questioning, but he didn't attach any significance to them in connection with the drinking water.

Where water is taken from the river or lake upon which the ship plies, no words can be too strong in condemnation of the use of such a man to oversee its purification. Even when there is employed as engineer of the vessel a man who is properly trained in water purification and who realizes the responsibility devolving upon him in regard to it, when an emergency arises his first care in practically all cases will undoubtedly be for his engines, and the water treatment will receive but scant attention. Therefore it is important to secure for ships, using such water supplies, some form of purification apparatus that will be automatic and foolproof in its operation, so as to give a safe water at all times with a minimum of attention.

Nor are these the only considerations, for the question of the initial cost of treatment apparatus, the cost of operating it, and the difficulty of always providing sufficient quantity without having recourse to contaminated sources are sometimes important. Not dismayed by the enormity of the problems involved, however, the various State departments of health and the United States Public

Health Service, cooperating with each other, are now taking practical and energetic steps toward removing this danger. That the sanitary authorities are not making a mountain out of a molehill, nor seeking to interfere where intervention is not necessary, I propose to show by a brief consideration of a few epidemics traced by competent investigators to the use of contaminated water supplies on shipboard.

In the last dozen years, more and more attention has been given to these matters. In 1909 Surg. J. O. Cobb, of the United States Public Health Service, in the Journal of the American Medical Association, called attention to the high typhoid rates among sailors and to the contamination of their drinking water as its cause. In the second report of the Lake Michigan Water Commission, Surg. G. H. Young, of the United States Public Health Service, reported an investigation of typhoid-fever rates among crews of Great Lakes vessels, attributing the high rates to contamination of water. The fact was brought out that water of the Great Lakes, which was used untreated, caused a higher typhoid rate on these steamers than existed on river or coastwise vessels, where the water had to be filtered or taken from a supply on shore.

One of the earliest epidemics resulting from using contaminated drinking water aboard ships to attract widespread attention occurred in 1907, when, during one short period of a summer cruise of a Great Lakes vessel, 77 cases of typhoid fever developed from this cause.

In July and August of 1912 an outbreak of gastrointestinal disturbances and of typhoid fever occurred at Clinton, Iowa, and in the neighboring cities of Davenport, and Sabula, Iowa, and Albany, Savanna, and Quincy, Ill. This epidemic was carefully investigated by Surg. L. L. Lumsden, of the United States Public Health Service, and Dr. H. R. Sugg, the health officer of Clinton.

Their studies showed conclusively that the outbreak was caused by infection contracted from some source during an excursion on the Mississippi River on July 29, 1912, abroad the steamer *G. W. Hill.* There were 1,550 passengers from the cities and towns named on the excursion, some of whom took their own lunches and beverages with them. Others ate and drank at various restaurants and lunch rooms in Davenport, but no large proportion ate or drank at any one place. Eight hundred, or approximately one-half the passengers, became ill after their return from the trip, however, and four died, so attention was directed to things consumed on the boat. By tracing the movements of the victims and others, and ascertaining what and where they ate and drank, it was shown that those who had gone to Davenport but did not return on the boat were not made sick, while all the victims who were interviewed in the course of the investigation gave a history of drinking water during the return trip from Davenport on the boat and none of those who drank no water aboard were taken sick.

Attention being thus directed to the drinking water, it was found that it had been much more turbid just as the steamer left Davenport than it had been before reaching that city. Furthermore, two passengers saw a deck hand manipulating the valves of the water storage tank on the upper deck, and one, who was seated against this tank, heard water running into it, all while the steamer was lying at Davenport, at the foot of Brady Street, in such a position that the water intake must have been within 20 feet of the outlet of the Brady Street sewer. Upstream from this spot several other sewers also discharged within a short distance.

The investigation cleared of suspicion all of the foods and beverages taken aboard the steamer by the excursionists, the sandwiches, ice cream, and drinks sold aboard the steamer, and the ice used for cooling the water, and fixed the responsibility for the outbreak upon the drinking water obtained thus at Davenport in close proximity to the sewer outfalls.

The apparatus for supplying the water on the boat consisted of a piping system and a Lynn stone filter, but, according to the statements made by passengers that the water from the pipes sometimes contained small twigs and bits of trash that couldn't possibly have passed through the pores of the filter, the water was either by-passed around the filter, or the filter stone was broken, permitting unfiltered water to be delivered by it.

In September, 1913, a party of 300 people chartered the steamer *Rochester* on Lake Erie for a trip from Buffalo to Put in Bay and Detroit and return, to attend the Perry Centennial Celebration. Another party, 122 in number, on the steamer *Greyhound*, followed the same itinerary and attended the same meetings at the same times.

Out of the 235 of the 300 members of the *Rochester* party, from whom reports were secured, there were 122 cases of gastroenteritis, 42 of typhoid, and five deaths. The *Greyhound* party furnished a valuable control in investigating this epidemic, since only 14 light cases of diarrhea occurred during and after the trip.

Careful inquiry on all points, made by Passed Asst. Surg. Hugh de Valin, of the United States Public Health Service, showed no probability of the causative infection having been acquired on shore at any of the places visited. During the entire season there had been more or less persistent diarrhea among the crew of the *Rochester*, together with four cases of typhoid fever, one of whom died. Inquiry into the times of taking in water for drinking purposes aboard the *Rochester* revealed the fact that twice during the trip water was taken, without purification, from very dangerous and highly polluted sources, one not far below the Detroit sewers, and on several other occasions from places where the water was sufficiently contaminated to be unsafe.

All data pointed to the water supply used aboard the *Rochester* as being responsible for both the crew's illness and for the extensive epidemic among the passengers. It is possible that the direct mode of transmission was by one of the crew, himself made ill by the water, passing the germs on to the passengers through the medium of food, yet the highly polluted water, used at least some of the time by these people while on the ship, was undoubtedly directly responsible for part of their illness.

In August, 1913, the U. S. S. *Gopher*, assigned to the State of Minnesota for use as a naval training ship, took on a company of naval militiamen and made a cruise in Lakes Michigan and Superior. Of the men aboard, 102 were from Duluth and 41 were from Pine City, Minn. During the cruise, and commencing about five days after starting, 60 per cent of the whole ship's company suffered from gastrointestinal disturbances, and three cases of typhoid developed in the Pine City detachment. A larger percentage of the men from Pine City were affected than of those from Duluth. The Pine City men were for the most part newly enlisted, whereas the majority of the Duluth men had been on similar cruises before and had become more or less immune.

Careful inquiry was made by Passed Asst. Surg. Hugh de Valin and the Minnesota State Board of Health relative to the food, milk, water, etc., used ashore at the various ports visited. No large proportion ate or drank at any one place ashore, so, as the character of the outbreak pointed to a common source of infection, the trouble was sought aboard ship. No outbreaks of similar diseases had occurred in any of the places called at by the ship nor in the home cities of the men.

The food, milk, and ice used aboard the *Gopher* were investigated and found to be pure, and other people using these same products were not subjected to such outbreaks. Search was made for a possible typhoid carrier among the crew, but none was found. By a process of elimination all possible sources of infection were disposed of except the water supply. This was found to have been taken untreated from the two lakes through the same pipe line and pumping system that was used for washing down the decks, often in grossly polluted harbors. Water for washing purposes in the toilets did not come from the storage tanks, but was continuously pumped from directly overboard, even when in harbor. The dangers of this practice are shown by the fact that several admitted having drunk water from the faucets supplying water intended solely for washing.

Water was taken into the storage tanks in several grossly polluted places, notably between Chicago and Milwaukee, near shore, where the sewage of Racine, Kenosha, Milwaukee, and other cities is discharged directly into the lake, and also 4 miles from Two Harbors, Minn. The men remarked about the difference in the appearance of the water as they passed from Lake Michigan into Lake Superior. As a result of the investigation the responsibility was fixed upon the water supply as the cause of the epidemic.

That the action of the engineer of this vessel in taking in water near polluted harbors is not an isolated instance is evidenced by the fact that a severe epidemic among the crew of another vessel was caused by taking in water when only 5 miles from Two Harbors during the same year.

Another epidemic of large proportions occurred the same month that the outbreak on the *Gopher* took place. The *Huron*, plying between Cleveland, Ohio, and Sault Ste. Marie, Mich., was involved in an epidemic wherein 150 passengers, or about 50 per cent of the total number aboard, were made sick. Most of the illness was in the nature of gastro enteritis, but there were seven typhoid cases and one death resulting from the outbreak. The ship started from Cleveland, took on unpurified water in the western end of Lake Erie, where the contamination of the water by the sewage of Detroit and other cities makes this a dangerous practice, then passed up the river and took water at various places in Lake St. Clair and Lake Huron. Curiously, the passengers who boarded the ship at the points first touched and made the round trip were about the only ones affected, as very few of those who came aboard at the various Canadian stops on the return trip from Sault Ste. Marie were made sick.

The outbreak clearly had a common source, and since the passengers came from widely separated points by various routes and no similar epidemics existed at the starting point nor at any of the points touched en route, it was evidently due to something on the ship. The only place, other than on shipboard, that could have been a common source of infection was the hotel in Sault Ste. Marie where all had dinner, but this was ruled out by the fact that the epidemic was in full swing before they reached this city.

Consequently the food, milk, ice, and water used on the ship were investigated by Passed Asst. Surg. Hugh de Valin and Asst. Surg. Joseph Bolton, of the United States Public Health Service. As a result of their efforts, the responsibility was again fixed upon the drinking water supply. It was found that no record was kept of the times when the drinking water tanks were filled and that they might be filled anywhere; also that water for washing in the toilet rooms was pumped continuously, in grossly polluted harbors as well as in the middle of the lakes, through the same intake and piping system as used for the drinking water. Between the chances of contaminating the drinking water thus and having passengers drink water from the faucets furnishing this wash water, trouble was sure to develop. Inquiry divulged the fact that smaller outbreaks of diarrhea had occurred more or less frequently among passengers, prior to this one which was investigated, while a number of the crew gave histories of persistent diarrhea during the entire season.

In the summer of 1916, an outbreak of typhoid fever which occurred among the crew of a Government dredge at work in the Mississippi River just below the dam between Minneapolis and St. Paul was investigated by the Minnesota State Board of Health and was attributed to the use for drinking purposes of raw Mississippi River water, freshly contaminated by Minneapolis sewage.

During the summer of 1920, a number of epidemics occurred all along the course of the Upper Mississippi from St. Louis to St. Paul, Minn. These epidemics were investigated by numerous local health authorities as well as by the representatives of the health department of the States affected and by the United States Public Health Service.

As in the cases already cited, all the possible sources of infection were considered, and as fast as each was found guiltless it was eliminated. Attention was early called to the water supplies of excursion steamers by the fact that all the sufferers went on excursions on one of two boats—the *Capitol* and the *G. W. Hill*—and by the similarity of the outbreaks to one which occurred at Red Wing, Minn., in 1917 and was traced to the contaminated drinking water supply of an excursion steamer, by the Minnesota State Board of Health. It will be noted that one of the vessels responsible for the trouble was the same one which caused the epidemic in 1912 at Clinton, Iowa, and its neighborhood. By the process of elimination the responsibility was finally traced indubitably to the water supplies of these two excursion steamers.

The apparatus on the *G. W. Hill* was essentially the same as when Surg. L. L. Lumsden inspected it in 1912. There was a Lynn No. 5 filter through which the drinking water and the water used for washing glasses and dishes was passed. The same sea-cock, intake pipe, and pump were used for the flushing, fire-fighting system, and for the drinking-water system, and water was often pumped for washing decks while lying at the bank of the river in close proximity to sewer outfalls. The crew's toilet was about opposite the water intake, on the other side of the boat, and not over 30 feet away. At the time of my inspection, samples of the raw and filtered water were collected. The bacteriological examination, made by the Minnesota State Board of Health, showed total counts of many thousands of bacteria at 37° and *B. coli* present in 1 c. c. amounts in both the raw and filtered water, and, to tell the truth, the filtered water was not very materially improved by the filtration process.

The *Capitol* had a similar intake, polluted by constant use at the sewage-laden levees of the river towns, also used for taking in drinking water when the storage tanks were empty. The crew's toilet was located 20 feet forward of the water intake, on the opposite side of the boat. Raw water was used at the soda fountains for washing glasses and dishes. A No. 5 Lynn filter was used for the drinking water. After passing through this filter, the water went to one of three heating tanks where it was supposed to be boiled for five minutes.

No apparatus was provided for insuring that the water be heated at all, much less boiled for any definite length of time. After being boiled (or not, depending upon the deck hand attending to these things) this water left the tank on the upper deck by the same pipe that had supplied it to the heating tank, thus permitting the boiled water from the tank to mix with the unheated water still in the pipe, thereby making useless the trouble taken to boil it. Some idea of the care taken to boil the water may be gained from the fact that the man having general supervision over this work was the one who said that it was safe to drink raw river water only 60 feet below a sewer outlet.

When I looked into the heating tanks to see the steam coils in the bottom, the water was as turbid as the river, and had to be drained out of the tanks before I could see the coils. Subsequent investigation showed that the filter stone was broken, permitting the water to pass through unfiltered, and the man in charge of it did not know it. Bacteriological examination of samples of this water was made also, which showed that the drinking water had the same *B. coli* content as, and a higher total count on agar at 37° than, the raw water. This high total count was no doubt due to aftergrowths in the tepid water of the tanks after heating.

Still another epidemic traced to polluted water supplies, though not so conclusively as in some other instances, is the following, traced by the New York State Department of Health. During the first week of August, 1920, four firemen on the steamer *C. W. Morse*, plying between New York and Albany on the Hudson River, were taken sick with typhoid fever. These four firemen lived together with eight other firemen on the boat and all ate at the same mess. The water supply used by these men showed the presence of *B. coli.* Milk was used very little by the crew and there was found to be no evidence against the milk supply or other foods. The tracing of the infection to a carrier was difficult, as 19 food handlers left the employ of the company during July, just prior to the outbreak, and could not be located.

The *C. W. Morse* takes its water supply both at New York and Albany by connecting street hydrants to five tanks in the hold of the vessel. From these tanks the water is pumped through pipes to various parts of the boat. The captain said that river water was never put into these tanks and that it could be done only with difficulty by connecting a fire hose to the sea cocks. On the lower deck in the bow of the boat was a wooden keg covered with a loose board top, and to get the water a cup had to be dipped into the keg. In the boiler room there was a water cooler and another in the pump room. These three receptacles were used by the crew.

Samples for examination were taken from the five tanks, from each of the two coolers, and from the keg. The result of the examinations showed *B. coli* in each of the three receptacles used by the crew, but not in the tanks. Unfortunately, no bacterial counts were made and the reports did not give the quantity in which the *B. coli* were found. Another set of samples, taken independently by Dr. Sautter, city health officer, showed *B. coli* to be present in one of the five tanks also, namely, the one supplying the dining room.

But why go on? Enough has been shown in the instances cited to indicate something of the seriousness of the problem and the necessity for immediate concerted action. I would fain speak of the remedies being used, in order to offset the rather lugubrious tone of this recital of disease and death, but the presentation of that feature is reserved for others.

In conclusion, I wish to thank all those, especially the State sanitary engineers and the officers of the United States Public Health Service, who have aided in the collection of data presented in the foregoing descriptions.

Mr. I. W. Mendelsohn presented the following paper:

THE POLICY CONCERNING CERTIFICATION OF INTERSTATE CARRIER WATERS.

In the administration of the present policy concerning the cooperative certification of water supplies used by common carriers for drinking and culinary purposes in interstate traffic, several matters bearing directly on this policy have been noted and will be placed before this conference for consideration. Before proceeding to these matters your attention is invited to the fact that the two fundamental premises in this policy, as adopted at the Surgeon General's conference in 1919, are—

1. The sources of water supplies used by common carriers for drinking and culinary purposes in interstate traffic are to be certified through the cooperation of the State boards of health, or similar State health bodies, and the United States Public Health Service.
2. In order to administer the work effectively it is necessary that each State board of health have an established and fully functioning division of sanitary engineering.

Because over 70 per cent of the water supplies used by interstate carriers are municipal supplies, Congress has expressed itself in no uncertain terms that the quality and safety of these water supplies are of more importance to the State than to the carrier and that each State should take the fullest measures to insure the satisfactory quality of its water supplies. While supervisory powers over waters used by interstate carriers have been placed in the Bureau of Public Health Service, it has been the intention of Congress that this control be carried out by the service with the cooperation and assistance of every State board of health and that no organization be set up in competition with the State health bodies.

Under the act of Congress of 1893, full authority is granted the Public Health Service to prohibit the use of an unsatisfactory water supply for drinking and culinary purposes by an interstate carrier. Unfortunately, full authority has not been granted State boards of health under acts of State legislatures to prevent the use by municipalities of water supplies of questionable purity and safety. There are many water supplies used by interstate carriers for drinking and culinary purposes which can not be considered as free from the possibility of pollution because of some defect in the waterworks system or because of the unsatisfactory operation of the waterworks plant. In some cases, such water supplies are considered unsatisfactory by the State boards of health and recommendations are made to improve the supplies, but the use of such water supplies is not condemned; in other cases, such water supplies are considered by State boards of health as dangerous to the health of the people and their use by the municipalities condemned until certain improvements are made. Accordingly, the situation is often presented of a municipality using a water supply condemned as unsafe by the State board of health and of an interstate carrier prohibited from using such a water supply under the cooperative certification policy, and all the while the people of the municipality are in greater danger of disease outbreak by far than the occasional traveler drinking the water. As a result, a double standard of safety and purity of water supplies is now in existence in many States, which is contrary to the intentions of Congress and unfavorable for an effective administration of the certification policy.

Many of the State boards of health desire that the use of water supplies by interstate common carriers be prohibited when such water supplies have been found to be unsafe by the State boards of health, and all possible action has been taken by them to stop the use of such waters by the communities. If such is the consensus of opinion of this body, the bureau will cooperate with you in enforcing the certification policy accordingly. What is desired for effective administration is one policy agreed to by this conference.

The second point concerns provisional certificates. There are a large number of water supplies, which are not considered by State boards of health as free from danger of contamination due to unsatisfactory operation or some defect in the waterworks system, and yet such water supplies are not considered of such danger as to be condemned for use by communities or by common carriers. There are also many water supplies concerning whose safety and quality sufficient data is not available. For all such water supplies some kind of certificate should be prepared, different from the "favorable" or "unfavorable" certificates, so that proper recognition could be given them in the certification policy.

In view of these conditions, it may be deemed advisable by this conference to have a separate certificate for the provisional use of a water supply, the wording of which would show that the supply was not approved because of certain defects in the waterworks system, and that the use of the water supply could not be approved until these defects had been corrected.

Placarding of condemned water supplies presents another matter for your consideration. The Public Health Service will cooperate with each State board of health in carrying out whatever is deemed advisable by the State board of health in such placarding in the

State, bearing in mind that, as far as local conditions permit, the procedure in all the States should be alike. The use of placards generally has been found of great value by State boards of health in improving their water supplies. But, from an administrative viewpoint, it has not been found advisable nor feasible by the Public Health Service to require the railroads to do the placarding. This case is analogous to that in which placards are placed by city health departments on the doors of city homes where occupants are afflicted with a communicable disease. In regard to placarding, one of the suggestions made to the service is that both the State board of health and the United States Public Health Service should be mentioned on the placard as condemning the supply; another, that placards be forwarded by the State board of health to the railroad station agents with the request that they be affixed over the taps at the station. From an administrative viewpoint, it would seem preferable that placards stating that the water supply was unsafe and its use on cars in interstate traffic was prohibited by order of the State board of health and the United States Public Health Service be forwarded by the State boards of health to the station agents with the request that they be placed over the station taps.

You will be interested to know that the American Railway Association, with a membership comprising over 600 of the railroads of this country, has formed a medical and surgical section to consider matters of health pertaining to the railroads. Through the cooperation of this section, the Public Health Service and the American Railway Association have agreed that all passenger cars now being constructed shall have coolers with separate ice and water compartments and that all passenger cars shall be so equipped by July 1, 1924. From results already obtained, it is believed that the cooperation of the medical and surgical section of the American Railway Association will prove of great value in making effective the administration of the certification policy.

Another matter for consideration is a policy for the supervision of water supplies on vessels. Despite the limited appropriation of $25,000 of the United States Public Health Service to prevent the interstate spread of disease, it was found necessary to commence such supervision in the past few months in view of disease outbreaks last year and in the past on vessels on the Great Lakes and the Hudson and Mississippi Rivers due to the use of polluted waters on board for drinking and culinary purposes. This supervision extends to all vessels plying in interstate traffic, and includes water supplies obtained ashore and afloat and water-supply systems on board the vessels used to furnish water for drinking and culinary purposes. Because of the large amount of additional investigative work involved, it is deemed advisable, from an administrative viewpoint, to divide supervision of vessel waters into two parts—the first part, concerning certification of water supplies ashore, to be carried out in cooperation with the State boards of health, similar to the present procedure regarding railroad waters; the second part, concerning the certification of vessel water systems and water supplies obtained afloat, to be carried out by the United States Public Health Service. It is intended to pay particular attention to vessels on the Great Lakes and the Mississippi River and its tributaries, considering first of all passenger and excursion vessels, and then freight and other vessels as funds and personnel permit. The fullest cooperation of all the State boards of health is necessary to make this supervision effective.

The States have been grouped into nine districts and a Public Health Service sanitary engineer placed in each to carry out certification of railroad and vessel waters. These sanitary engineers, as far as possible, will be available to assist the State boards of health in their districts in this work and in developing the sanitary engineering divisions in those State boards of health. In addition to these district sanitary engineers, representatives of the State board of health have been appointed in 14 States as collaborating sanitary engineers of the Public Health Service to assist the State boards of health temporarily in carrying out the certification policy until more adequate appropriations are obtained from the State legislatures.

Largely as a result of the cooperative policy, functioning sanitary engineering divisions have been established in 10 State boards of health in the last two years. At present there are 35 functioning State sanitary engineering divisions, in addition to three other divisions which will be established beginning July 1, 1921. Present indications are that within the next two years sanitary engineering divisions will be established in three other States. Valuable assistance has been rendered practically every State board of health in improving the municipal water supplies through the administration of this policy. According to the certificates received and the information obtained, no condemned water supplies are being used by common carriers for drinking and culinary purposes in interstate traffic. The sources of water supplies have been certified, however, in only 50 per cent of the cases during the present fiscal year.

From the experience of the past two years in carrying out the certification policy, it is believed that consideration should be given the following matters to make this policy of greater value to all State boards of health:

1. That there be one policy agreed to by the State boards of health concerning water supplies of unsatisfactory quality and safety.

2. That water supplies which are not considered either safe or dangerous, or concerning which sufficient data is not available be included in the certification policy by some form of provisional certificate.

3. That placards for prohibited supplies signify the governmental authority condemning the water supply and be posted through some form of agreement with the carriers.

4. That some policy concerning the supervision of vessel waters and vessel-water systems supplying water for drinking and culinary purposes on board vessels be adopted.

The bureau desires your advice in formulating procedure which will solve the problems presented above.

Mr. Ellis S. Tisdale submitted the following paper:

COOPERATION OF STATE HEALTH DEPARTMENTS IN THE CERTIFICATION OF INTERSTATE WATER SUPPLIES.

Mankind is subject to certain diseases, for the eradication of which both the science of medicine and of engineering are necessary. They furnish, as it were, points of contact for these two professions. Notable among these diseases stand yellow fever, malaria, and typhoid fever. The latter disease has a very definite relationship to drinking-water supplies. Probably the subject of "interstate water supplies," fully as much as that of malaria or typhoid fever, has been instrumental in bringing together from all parts of the United States this representative body of sanitary engineers. The first step tending toward the formation of a State sanitary engineers' association, if I read the movement rightly, was the commendable practice by certain State health officers of bringing their sanitary engineers to the annual conference of State and Territorial health officers, that they might profit by the engineers' advice on matters where the sciences of engineering and medicine overlapped.

In 1919, due to the growing importance of sanitary engineering divisions as they relate to this question of interstate water supplies, an invitation went out to all States requesting the presence of the sanitary engineer at the annual conference. That the subject of interstate water supplies is an important one is amply attested by the increased consideration being given to this subject by health officials when they meet to discuss their mutual problems. In 1918 and again in 1919 this question was brought up at the annual conference of State health officers with the United States Public Health Service.

That the subject is receiving the thought which it merits is due probably to the persistent, untiring efforts of Dr. Allen J. McLaughlin, Assistant Surgeon General of the United States Public Health Service. Back of all movements of progress in our history, be they of art, science, or government, will be found leaders, men who by their constructive thought and action, have led the way. The sanitary engineers throughout the United States have had such a leader in Dr. McLaughlin, and he has put the virility and forcefulness of his personality into the problem of bettering interstate water supplies. His has been the guiding hand which is placing sanitary engineering work in the State health departments on a higher plane. For a long time this work of certification was carried on in a way that savored of red tape and impersonality. Of course, to a certain extent this is unavoidable, where supervision is maintained over a large area like the whole United States and must be carried on for the most part by correspondence. But at last someone's vision and active interest has found a way to eliminate much of the rigidity and inelasticity of the work of certifying to the purity of these supplies.

The type of certificate in use in the Treasury Department from 1913, when interstate water control was started, up to 1919 was a poor instrument for registering the record of interstate water supplies. The standard upon which the whole scheme of certification was based was that of bacteriological tests alone. It was not a medium through which could be transmitted the mature judgment of the engineer investigating and certifying the water supply. It provided no sanitary survey record, an element which is considered to-day of as great if not greater importance than the bacteriological content.

The Public Health Service, desiring to make the procedure of certification more flexible and in accord with the best judgment and experience of the sanitary engineers of the States, had a thorough and detailed investigation made by representatives of the service. During 1918 and 1919, Dr. F. A. Carmelia and Mr. C. N. Harrub visited each State department of health and obtained information regarding the facilities, the organization, and personnel of the sanitary engineering division or that division which was looking after the water supplies in the State. Not only this, they attempted to obtain the viewpoint and opinion of the engineers actually doing the certification. Constructive criticism was welcomed.

As a result of this very detailed study, data of the most valuable character was gathered and correlated. The common factor in the criticism regarding the certification process seemed to be the inadequacy of the certificate based upon single bacteriological analyses.

Dr. Carmelia very clearly stated, in outlining future plans before the annual conference in 1919, that sufficient consideration reveals the unsoundness of the premise that the control of water supplies should be standardized for all States alike and accordingly also for use in interstate traffic for drinking and culinary purposes.

It seems to me that this whole question has an analogy in a rough way to the sanitary privy situation. One final arbitrary standard was sought for years through patient research and extensive field experiments. At last, in this field of rural sanitation, the conclusion was reached that we must rely upon the judgment of the engineer as to the type of privy best suited for the locality and situation. With regard to the certification procedure, Dr. Carmelia says, in summing up his results: "It is impossible to make arbitrary standards and procedures take the place of the exercise of judgment in determining the potability of any given supply. And judgment comes with experience. Each water supply must be weighed individually on its own merits." Thorough consideration given the problem of certifying water supplies also shows clearly the advisability of limiting the cooperative control to the several States and the Public Health Service. Local municipal control reporting direct to the service makes an undesirable short circuit which creates havoc with the entire cooperative arrangement between States and the Public Health Service.

The basic future Federal program, which was outlined in Dr. Carmelia's paper before the annual conference in 1919, consisted of three important features. They were: (1) A sufficiently elastic regulation to meet the regional diversities in a satisfactory and practical requirement for potability. (2) A definite program and offer of assistance to those States which are most in need of and can most profitably take advantage of such assistance. (3) A definite plan whereby the Public Health Service can become a medium of interchange of ideas, laws, and procedures among the various cooperating States for effective coordination of effort for the common advancement of water control.

Let us see how practical and workable these three channels of activity have proved to be. The revised regulation adopted at the 1919 annual conference was a great step in advance. Its main provisions can be briefly summarized as follows:

1. It provides that the safety and sanitary quality shall be based upon (*a*) sanitary survey, (*b*) bacteriological analyses, (*c*) chemical analyses. Survey and laboratory methods shall be followed which are acceptable to the Surgeon General of the Public Health Service.

2. Certificates may be issued only by officers of the Public Health Service or by the respective State health departments having jurisdiction over the water supply. No other authorities will be recognized.

3. The period of certification is made semiannual in general; but when common sense and judgment show the advisability, an annual survey and certification is sufficient.

4. Proper handling of the water supplies in placing water on trains at division points and terminals is provided for. Also in all new equipment, ice is not to come in contact with water in the water cooler.

5. The regulation is extended to cover vessel waters as well as railway waters. This policy of certifying vessel waters covers the entire United States and provides for water obtained both ashore and that furnished by water supply systems on board vessels.

The second feature of the Federal program relates to the work of assisting in the establishment of new divisions of sanitary engineering, for this division is the State machinery which should do the actual work of certification.

The Public Health Service has no desire to set up a separate and duplicate set of machinery throughout the United States to handle this work of safeguarding interstate waters. It would be an uneconomic expenditure of funds and effort. It does desire to use to the fullest extent the existing State machinery. The division of sanitary engineering in each State health department may well be likened to a link in the chain of this consolidated machine, which functions to protect and safeguard the water supplies used in interstate traffic. The links of the chain are weak and ineffective and allow disease to creep in wherever the sanitary engineering divisions are lacking or too small to function properly.

The position which the service aims to fulfill is to care for the water supplies in these weak States and to demonstrate to the States the need for a sanitary engineering division and to strengthen already existing organizations. How successful has been the endeavor in this direction during the year just passed? Missouri, South Dakota, New Hampshire, Mississippi, Georgia, Kentucky, and Tennessee have made provision for a sanitary engineering division in the past year, mainly due to the stimulation and effective work of the Public Health Service engineers. The first three named States will start the work of engineering July 1. The States of Tennessee, Kentucky, and Georgia for quite a period of time received the help of a service engineer, but now finance a full-time engineer themselves. In Mississippi the engineer was appointed in October, 1920. Thus in these seven States successful demonstrations have been staged. Work is now being carried forward in Washington and Oregon and other Western States to place the engineering work on a full-time basis. Also Arkansas, Oklahoma, Nebraska, and Delaware received considerable assistance during 1920.

The third feature of the Federal program has also been functioning. The medium in the Public Health Service for the bringing of all State sanitary engineers into closer contact is the office of corresponding secretary of the State Sanitary Engineers' Association, which is maintained by the United States Public Health Service. The association is as yet an infant, but there are great possibilities for it in the future, if all State health departments sense their responsibilities and the engineers themselves lend their loyalty and efforts toward the development of the association. I am much indebted to the present corresponding secretary for help given in getting up-to-date information upon the subject matter of this very paper.

What are the fundamental items of a State program which will match the Federal program which was proposed in 1919 and is being carried forward with good promise?

1. The fundamental attitude of the Public Health Service must be understood and an expression made by each State whether it will cooperate along the lines indicated. This cooperative contract can not be properly carried out unless each party understands his part to the contract.

2. The certificate should be carefully considered by the State health department, and if any points of difference arise they should receive free discussion.

3. Uniform laws should be adopted in each State with regard to the railway sanitary code as promulgated by the "committee on health and medical relief" at the annual conference last year.

4. The question of the certification of vessel water needs careful consideration and an expression made of the policy which will be adopted by each State.

Let us see what the State program, consisting of these four points, has to offer and how the States can best proceed with their part in the cooperative scheme. Probably the greatest factor in getting the first point well established—that is, a conception of the Federal program and expression from each State as to its part in the contract—has been the bringing of the service engineers and State engineers together. It has been accomplished in two ways, (1) by helpful visits of inspection of the service engineers to the several States and (2) by the coming together of the men in the annual conference last year.

The second point deals with consideration of the certificate itself. Can any suggestions for betterment still be made so that the certificate itself or its issuance will be even more practical than at present? The question has been raised as to whether it would not be preferable to express the bacteriological findings in a different manner. At present the certificate asks for the average number of *B. coli* per 100 c.c. and the total content of 37° C. bacteria per c.c. Would it not be better, in view of the varied conditions both with respect to laboratory equipment, personnel, and methods, to state the number of times that *B. coli* are found present in 1 c.c., 10 c.c., or 20 c.c. of the samples examined. I understand that the State of Kansas has adopted this way of reporting the *B. coli* content. It seems to me that a better bacteriological picture would thereby be given and this particular section of the certificate improved.

What about provisional certificates? During March, 1921, four rulings by the Public Health Service were issued which dealt specifically with this question. It is the opinion of at least some of the State engineers, who have been following closely the certification of railroad supplies for many years, that these rulings regarding provisional certificates will seriously retard progress. Whereas, formerly the State department of health, through refusing to issue a certificate, had a real lever with which to work to make safer municipal water supplies, now this help has been withdrawn. Let these features as to the form of certificate regarding bacterial content and the issuance of provisional certificates receive free discussion. If State machinery and personnel are to be freely used in developing this cooperative plan, is it not wise and fair that an expression be obtained from them before far-reaching decisions are made which affect the States and their work?

The third feature of the State program offers the suggestion that an attempt be made to obtain a uniformity of laws in the several States with respect to a sanitary code. The committee on health and medical relief of the annual conference of State and Territorial health officers worked with a will in drawing up a sanitary code which would be agreeable and satisfactory alike to the railroads, to the Public Health Service and to the States. At the annual conference in 1920, this railway sanitary code was officially adopted. I understand that already five States—Alabama, Florida, Kentucky, Minnesota, and Wisconsin—have enacted it into law. The enactment of the code in each State would aid materially in the work which the Public Health Service has under way of bettering the handling of interstate supplies at stations. Considerable discussion has arisen in the past as to whom this duty belonged. The several district service engineers are now attempting to supervise and better this feature of the work, especially at the big terminals, and it will be of great assistance to have uniform laws regarding this matter in all States.

The sanitary code provides that unsatisfactory waters shall be posted in the stations. I know in West Virginia this way of showing the unsatisfactory character of water to the public has enabled our department to make many improvements otherwise impossible. Even though there is a contention by the railroads as to the unfairness of placarding a supply and forbidding its use on trains when the community still uses it, I feel that the adoption of a temporary provisional certificate allowing the use of the water and not forbidding it, takes from us an effective lever for bettering municipal supplies. And, as I understand it, bettering public water supplies is one of the main drives which the Public Health Service is making. However, each State should make clear to the Public Health Service whether the State desires to take the responsibility for the placarding or have the Public Health Service assume it.

The fourth and last point with which the State is concerned is formulating her program relative to vessel water supplies. The

United States has been divided into nine districts in the water control work of the Division of Domestic Quarantine. A service sanitary ènginer, is, or will be, assigned to each of these districts. Supervision of water systems on board vessels comes directly in the line of duty of these engineers and they should know the policy of the State with regard to vessel water supplies which are obtained on shore. Thus they can plan their work accordingly.

I have tried to present briefly the essential features as I see them of a true cooperation between the States and Public Health Service which, if effected, will promote the work of making safe interstate water supplies. To me there is great hope in this tentative organization of ours, the State sanitary engineers' association. It gives that personal touch which is so essential in vitalizing an understanding. The engineers of the many States and of the Public Health Service meet and exchange ideas. Thus we have a real clearing house to rid the atmosphere of any frictions, mistaken ideas, or false impressions. It furnishes that opportunity, so essential to real progress, of getting away from one's work and getting the other fellow's viewpoint on the question. Such a meeting as this affords us a platform, as it were, from which we can command a view of our present position, a purchase by which we may move it.

With the older States, where the work has progressed considerably, contributing their knowledge and experience to help the States younger in this work, and with a leader of vision, judgment, and force such as Dr. McLaughlin, who has advanced and is advancing the sanitary engineering side of public-health work to the utmost of his ability, we engineers should give our utmost loyalty and cooperation toward making this organization an effective unit for progress.

A motion was made, seconded, and approved to appoint a committee to consider the matter of certification of water supplies used by common carriers for drinking and culinary purposes in interstate traffic. The committee consisted of Mr. Tisdale, chairman; Mr. Emerson, Mr. Gage, Mr. Rich, and Mr. Mendelsohn.

The conference then adjourned for the day.

Morning Session, June 2, 1921.

The second day's session was called to order at 9.30 a. m., Mr. Emerson presiding.

Mr. A. E. Gorman presented the following paper:

REPORT OF CONDITIONS UNDER WHICH DRINKING WATER IS BEING SUPPLIED ON VESSELS OPERATING IN INTERSTATE TRAFFIC ON THE GREAT LAKES, WITH REFERENCE TO TYPHOID FEVER AMONG GREAT LAKES SEAMEN.

The problem of maintaining a safe water supply for drinking and culinary purposes aboard vessels operating on the Great Lakes is different from that for transoceanic, coastwise, or river vessels, because of the physical and chemical properties of the water of these lakes. The high salt content of sea water automatically prohibits its use for drinking unless distilled; the turbidity of the waters of the large navigable rivers of this country often serves as a check against their use for similar purposes on river vessels, because people are becoming more and more suspicious of an unclean water; but on the other hand, the fresh waters of the Great Lakes with their agreeable taste, low turbidity, and relatively low temperature, meet all the outward demands of seamen and the traveling public for an ideal drinking water supply.

While it is true that in large areas of the Great Lakes, the waters are of high sanitary quality and might be safely used for drinking purposes, nevertheless in the vicinity of the larger cities, they are often grossly polluted by sewage from the cities and as a result are usually highly contaminated.

The heaviest merchant shipping and the greatest passenger traffic is, of course, centered around the large lake cities, so vessels in arriving and departing, as well as while docking, at these ports are in waters subject to and grossly contaminated by sewage pollution. Furthermore, since vessels travel in fairly uniform courses between ports and as the sewage from these ships themselves is discharged directly overboard, there is always the potential danger of the sewage from one ship contaminating the water supply of others in its wake, even if the seamen of the latter vessels are careful to fill the drinking water tanks aboard only when the ship is distant from possible shore pollution.

Cobb,[1] in 1909, called attention to the dangerous practices in connection with the supplying of drinking water on Great Lakes vessels and showed that the high typhoid fever rate among lake seamen was contributed to largely by contaminated drinking water supplied aboard. Young,[2] in 1910, concluded from a study of typhoid fever among seamen that its rate was higher among Great Lakes seamen than those working on coastwise or river vessels, and also higher than the rate in cities of the Lakes district. The outbreak of an epidemic of gastro enteritis and typhoid fever among members of an excursion party which took passage on steamship *Rochester*, in the summer of 1913, is a classic of its kind. De Valin, in his report on this outbreak, states that information received from 235 members of this party showed that 122 cases of gastro enteritis and 42 cases of typhoid fever, with 5 deaths, resulted from the drinking of contaminated water aboard this vessel, taken on from Lake Erie. In 1914, De Valin also studied the typhoid fever epidemics on steamship *Gopher* and steamship *Huron* and concluded that contaminated water from the lakes was responsible for both of them.

---

[1] Surg. J. O. Cobb, United States Public Health Service, Journal of American Medical Association, vol. 53, p. 2057, Dec. 18, 1909.

In 1915, a systematic study of the methods under which drinking water was being supplied on vessels operating on the Great Lakes was begun. This work was carried on under the supervision of Surg. J. O. Cobb, United States Public Health Service, who was then officer in charge of the Great Lakes sanitary district, with headquarters at Chicago, Ill.

As a result of this investigation, it was found that in general the practice on lake vessels in connection with the supplying of drinking water was entirely unsatisfactory for proper protection to seamen and the traveling public; and that the apparatus then in use for sterilizing such water aboard many of the passenger vessels was "woefully inefficient." An excellent report on this investigation and the work which followed was written by Cobb Williams, and Letton, of the Public Health Service, and published in Public Health Reports of October 13, 1916.

In view of the inefficiency of the apparatus then used aboard vessels for disinfecting lake water, a study was subsequently made of their design and operation, for the purpose of assisting in the development of adequate control and operating appliances necessary to make them satisfactory for the purpose for which they were purchased. The different processes then in use for treating lake water on passenger vessels operating on the Great Lakes were rapid sand filtration, electric rapid sand filtration, filtration followed by ultraviolet ray sterilization, sterilization by calcium hypochlorite, and sterilization by liquid chlorine. A study was also made of other types of water disinfecting apparatus then on the market, to determine their efficiency and practicability for use on vessels.

After several recommended adjustments were made and additional control devices included in the apparatus studied and tested, three methods for disinfecting lake water aboard vessels were finally approved, namely, distillation, heat treatment by steam, and ultra-violet ray sterilization. The first method was described in letter of March 10, 1916, sent out by the Great Lakes sanitary district to all owners and agents of lake vessels as being "foolproof, automatic in action, and not dependent on the human agency for its efficiency;" and the other two methods as, "as near foolproof and automatic in action as possible with any apparatus having moving mechanical parts."

---

[2] Surg. G. B. Young, United States Public Health Service, Second Report of the Lake Michigan Water Commission, p. 97, 1911.

The following regulations announced in Treasury Department Circular No. 72, dated February 12, 1917, were adopted as a result of the investigations of the Great Lakes sanitary district:

> On and after the official opening of navigation in 1917, any person, firm, or corporation operating vessels in interstate traffic on the Great Lakes will be required to furnish on such vessels water for drinking or culinary purposes under one of the following conditions:
>
> (*a*) If water for drinking or culinary purposes is not obtained ashore, it must be treated by an approved method.
>
> (*b*) If water for drinking or culinary purposes is obtained ashore, it must be from an approved source.
>
> On and after the official opening of navigation in 1917, the piping system on all vessels must be so arranged that no connection can be made between the drinking-water system and any other water system.
>
> On and after the official opening of navigation in 1917, an approved sign reading "Do not drink this water," must be properly placed at every tap or other outlet not connected with the drinking-water system.
>
> Lake carriers are requested to acknowledge the receipt of this letter.

From the first, few of the vessel owners and managers were interested in the provision of these regulations allowing the use of water obtained from an approved source or sources ashore, and therefore, in order to comply with the law, immediately set about to determine which of the different apparatus for treating water, in accordance with the three approved methods, would be most practical for installation on their respective vessels. The reason for this action is quite obvious to one familiar with conditions in connection with Great Lakes shipping.

On the large passenger boats having well-appointed staterooms, parlors, and dining rooms, great quantities of water are used for washing, bathing, cooking, and drinking purposes. Tanks for storing sufficient water obtained from a source ashore to last a trip, whether overnight or of several days in length, would take up considerable space on a vessel. The stop-over at some ports was not sufficient to allow filling of these tanks. Also, at several of the large cities on the lakes, the public water supply was periodically turbid and in general unpopular with seamen, because of not infrequent disagreeable tastes in same caused by a chemical used for sterilization. This water was therefore not considered as desirable for drinking, cooking, and other uses on passenger vessels as the lake water which could be taken on en route. Furthermore, on a number of these vessels apparatus for treating lake water had already been installed.

In freight shipping the docks are along rivers, canals, and slips at the cities, and the wharves at which the vessels stop are very often not equipped with hydrants for supplying drinking water. Bulk freighters load and unload at many different wharves throughout the navigation season, and therefore even if such water was conveniently available at one port, it might not be at another. Furthermore, these vessels are often several days en route between ports and can not afford to be dependent for their drinking water supply on sources ashore. The distillation of lake water was given most serious consideration by owners of freight vessels, because the quantity of water used for drinking purposes aboard these ships was relatively small and steam was conveniently available.

For companies operating vessels in regular ferry freight or excursion service of a few hours' run and calling at the same wharves each trip, to obtain drinking water from sources ashore was a simple matter.

The expense to the shipping interests in complying with the new regulations of 1917 was not a small item, and although they registered objections, because of this, at the time, when it was made known that the policy of the United States Public Health Service would not be altered, they met the situation promptly. For the owners of vessels operating in passenger service on which water-treatment apparatus of an approved type were already installed, it was only necessary to make the specified changes or purchase additional control equipment in order to meet the Federal requirements. But freight carriers on whose vessels drinking water had always been obtained direct from the lake were obliged to purchase entirely new treatment apparatus and equipment.

Unfortunately for this work, shortly after the opening of the navigation season of 1917, this country entered the World War and the personnel of the Great Lakes sanitary district was shortly afterwards detailed to war service. In consequence, little supervision or control was exercised over the water supplies on the lake vessels that season, after the treatment apparatuses were installed. Not until the summer of 1918, or over a year later, was any regular supervision again attempted by the Public Health Service. At that time it was found that on many of the vessels the apparatuses for treating lake water, used for drinking and cooking purposes, were not being properly operated, and in many instances were not being operated at all.

The reasons for this laxity are not difficult to understand. A large percentage of Great Lakes seamen did not then, and still do not.

appreciate the potential dangers in connection with the practice of obtaining drinking water used on vessels from the lakes. They are not a little bit suspicious of and often entirely out of sympathy with any treatment process for disinfecting water, preferring to drink the clear, cool, and agreeably tasting water direct from the lakes. The " flat " taste of distilled water was the subject of much criticism by seamen on freighters the first year during which drinking water on these vessels was distilled, and even now there are many seamen who dislike such water. In addition to these features, the operation of the new water treatment apparatus demanded the attention of the engineers or their assistants, and, not being a part of the machinery necessary for the navigation of and the work aboard the ships, these apparatuses were often neglected.

Although on account of the demand for the service of its officers in war work the Public Health Service did not attempt to maintain an effective control over the drinking water supplied passengers and crews on Great Lakes vessels after the regulations of 1917 became effective, nevertheless, through the activities of the Detroit department of health excellent control measures were carried out on a majority of the large lake passenger vessels. As early as 1915 the Detroit department of health had made careful studies of the conditions under which drinking water was supplied on passenger vessels calling at that port, and some of its investigations were entirely pioneer work in this line. The stand which this health department has taken is that the sanitary quality and safety of the drinking water on the passenger vessels calling at Detroit is an important factor influencing the health of its citizens, and therefore is a public health problem to be solved locally, if not efficiently handled by other agencies. As a majority of the large passenger vessels call at Detroit, this far-sighted policy of that city's health department has been far-reaching in its effect.

During December, 1920, and January of the present year the writer was detailed to make a study of the conditions under which water used for drinking and culinary purposes was being produced on vessels operating in interstate traffic on the Great Lakes. An investigation was made, in this connection, of the number of vessels of different classes in service on the lakes, of the treatment apparatus used aboard each for disinfecting drinking water, and of the typhoid fever cases among seamen in the Great Lakes district since the regulations of 1917 went into effect. The following table gives the number of American registered vessels of different classes reported as operating on the Great Lakes during the navigation season of 1920 and the number of water treatment apparatuses aboard same. Vessels listed as over 300 gross tonnage engage generally in interlake traffic:

Type.	Vessels.	Water-treatment apparatus.	Per cent treatment apparatus.
300 gross tonnage or less:			
Passenger	29	....	....
Freight	24	2	8.4
Barge	17	....	....
Car ferry	....	....	....
Gross tonnage over 300:			
Passenger	58	36	62.0
Freight	481	403	83.7
Barge	128	47	36.7
Car ferry	20	6	30.0
Total:			
Passenger	87	36	41.5
Freight	505	405	80.0
Barge	145	47	32.4
Car ferry	20	6	30.0

With the one exception of the steamship *Calcite*, on which drinking water is sterilized by the ultra-violet ray process, all freight steamers, car ferries, and barges listed above as having water disinfecting apparatus aboard are equipped with stills. On the vessels of this class not so equipped, especially on those of over 300 gross tonnage, the drinking water is obtained regularly or when necessary direct from the lakes.

The water-supply system on the large bulk freighters, which class represents 76 per cent of all the vessels operating on the Great Lakes, are quite similar. Water used aboard for general purposes, such as for boilers, washing decks, "shooting" ashes, fire service, etc., is taken on from the lakes through a main seacock, and pumped throughout the ship as needed. Water-storage tanks of from 300 to 500 gallons capacity, usually three or four on the upper aft deck and two or three on the upper forward deck supply water under gravity pressure for washing in the quarters of the officers and seamen aft and forward, for general purposes in the galley, and for flushing toilets. These tanks are usually filled from the fire-service line on the upper decks through hose. As a rule care is taken to fill them when the ship is several miles out in the lakes, and always before entering port.

The water which is to be distilled for drinking purposes is usually, although not always, delivered to the still by a special pump. In many cases this pump is the same one which pumps cooling water to the engines and shaft bearings; and on not a few vessels this water is taken on through a special seacock. The stills on the lake freight vessels are practically all of 25 to 30 gallons per hour rated capacity. The condensed steam from a still is discharged into a collecting tank of about 100 gallons capacity, in which a float arrangement is set for automatically turning on the steam supply to a small horizontal pump when the tank is filled. This pump delivers the distilled water to the storage tank on the upper aft deck, and its steam supply is automatically throttled when the collecting tank is emptied. The distilled water storage tank is similar to and set alongside of the storage tanks for untreated lake water. Unless it is conspicuously marked to identify it and the covers locked, it would not be unnatural for an ignorant seaman or even inconvenient for a careless one to fill this tank when the other water tanks are being filled. The writer visited five vessels in South Chicago in one day last month on which this very thing had been done.

The distilled water is delivered by gravity pressure through a separate piping system to the drinking-water taps on the decks aft or in the galley quarters. On most of the freight vessels this water is first cooled by passing through coils set in the ice box. There are usually two or three drinking-water taps on the aft deck, but none forward or in the lower engine or boiler rooms. As a result, if a seaman in any one of these parts of the ship desires a drink of water and does not care to go aft or above deck to obtain distilled water, he may drink untreated lake water either from cooling jets to bearings or a pet cock in the manifold piping, if available. This water is usually cold. In the forward quarters lake water is available at all taps, although signs are posted over each, warning that the water is not to be used for drinking. During the summer months this water is not likely to be as cool as that at the drinking-water taps aft, because the storage tanks located on the upper deck are exposed to the sun. In the engine room, however, cold lake water may be readily obtained from the sources described above, and therefore, unless some provisions are made to supply cold distilled water to all parts of the ship, it is certain that lake water will be drunk by seamen. The practice of engine-room and fire-hold employees is especially dangerous, because they are often ignorant of the waters through which the ship is passing. It would be interesting to study the occupations of the Great Lakes seamen who have been hospitalized in the last few years for typhoid fever and to note the effect of this practice.

In the galley quarters the water-piping system on many freight vessels is so arranged that violations of the interstate quarantine regulations is made easy. Over the sink in the galley three taps are usually located. One is for hot water from the hot-water boiler connected to the range; a second is for untreated lake water direct from the storage tanks on the upper deck; and the third is for the cold distilled water. It is alleged, of course, that the untreated water is used only for washing in the galley quarters, and a sign is placed over the tap in accordance with the regulations, stating that this water is not to be used for drinking purposes. However, when the still is not in operation (the writer has been on several boats this spring on which the stills were not even connected) the employees in the galley have no other cold water to use except this untreated lake water.

As stated above, among Great Lakes seamen there is no little prejudice against the use of distilled water for drinking and cooking purposes. Thus an engineer or his assistants may willfully neglect the still, and even though this supply of water becomes exhausted, the employees in the galley are not liable to report this fact or even register a complaint as long as the untreated lake water is available. For real protection of the health of seamen, it is believed that no untreated water should be allowed in the galley quarters. The complaint that a 30-gallon per hour still will not supply sufficient distilled water for drinking and culinary purposes for 30 men aboard a vessel is not well grounded if this water is at all economically used. The Lake Carriers' Association, which body represents about 80 per cent of the freight vessels operating on the Great Lakes, has recommended that the untreated water supply be allowed in the galley, but that the tap be removed from over the sink and located at a point 18 inches from the floor, so that this water could be drawn in pails for use in cooling hot water and also for washing and scrubbing purposes in the kitchen.

It is known that on many of the freight vessels the stills have not been used regularly since they were installed, but it is believed that on a majority of these vessels care has been given to their operation. One instance was reported to the writer this spring where the condensed steam collecting tank from a still was filled regularly with lake water, direct from the general service supply, through a hose, the still not being operated at all, although it was properly installed and connected.

Apparatus for treating lake water by all three of the approved methods have been installed on passenger vessels. On some of the vessels of this class, having short routes only, water from certified sources ashore is carried, while on ferries of few minutes' run no water at all is supplied passengers. The following table is a compilation of the different methods by which water for drinking and culinary purposes on passenger vessels of American registry of the Great Lakes is obtained, as reported by the owners or managers:

Source and treatment.	300 gross tonnage or less.	Over 300 gross tonnage.	Total.
From lakes treated aboard by—			
R. U. V. sterilization	....	27	27
Heat treatment by steam	....	5	5
Distillation	....	5	5
From lakes untreated	25	11	36
From sources ashore	4	10	14
Total	29	58	87

On most of the passenger vessels having the ultra violet ray and steam ejector apparatus for disinfecting lake water, all the water on the ship except that used for washing decks, flushing toilets, and in the boiler and engine rooms is treated, the operating companies preferring to incur this expense rather than have to post warning signs in all washrooms, staterooms, and on decks over taps at which untreated water would otherwise be available. The few large passenger vessels on which stills have been installed, have the dual water systems aboard, owing to the expense of supplying distilled water for other than drinking purposes and consequently in the washrooms, staterooms, and kitchens untreated lake water is available, although over the taps warning signs are posted.

Separate seacocks and pumps are provided on most of the passenger vessels for taking on and delivering the lake water to be treated aboard to raw water storage tanks. From these tanks the water is pumped to or through the treatment apparatus and as discharged from same is piped to the sterilized water storage tank or tanks either under gravity pressure or the direct pressure from the pump. It is then pumped to the distibuting system throughout the ship at a pressure of from 30 to 40 pounds per square inch. On several large passenger vessels, no storage for sterilized water is provided at all, the water being pumped through the sterilizer to the distributing system direct. As the new regulations do not permit the existence of by-passes, the owners of these ships are now arranging for future installations of reserve tanks. The sterilized water storage tanks on most passenger vessels are located in the hold of the ship. On a few of these vessels the sterilized water storage tank is formed by a bulkhead across the ship, the hull serving as part of the tank. This is a very bad practice, as the vessel might strike an obstruction in a channel and open a seam in the hull of the ship allowing contamination of the sterilized water by sewage polluted water. On one vessel operating out of Chicago, a sewer line was found to pass through the drinking water storage tank.

By-passes around all or part of the water treatment apparatus were found installed on every passenger vessel on the Great Lakes which the writer has inspected to date. Cross connections between the treated and untreated water systems aboard were also found on many ships, the two systems being separated only by hand-operated valves. In three specific instances the valves in by-passes were found open while the water-treatment apparatus was in operation. These by-passes and cross connections are of course potentially dangerous and under the new regulations are prohibited.

In the ultra-violet ray process for sterilization, the lake water must first be filtered to remove any turbidity, prior to passing through the sterilizer. This is because these rays will not penetrate any solid material, except fuzed quartz and ice, and therefore bacteria in the water passing through the sterilizer might be protected by the shadows caused by tiny particles in suspension. Pressure filters are used on all the boats for this preliminary treatment. Fortunately, the waters of the Great Lakes are not often very turbid.

The efficiency of the mercury vapor lamp, used in this process, for emitting ultra-violet rays of sufficient intensity to sterilize the water at the rate it is passed around the lamp, depends on the voltage across this lamp. In order that no water may pass through the sterilizer before the voltage across the lamp has reached the range of its maximum efficiency, a solenoid-operated valve is placed in the water line to the sterilizer, which is supposed to automatically close when the lamp is not lighted and not to open again until the voltage across the lamp has reached at least 135 volts. In checking the operation of these solenoid valves, the writer found several of them opening at much lower voltages, and adjustments were made accordingly. Where such conditions existed, of course, there was danger of water passing to the storage tanks before being effectively sterilized. All the ultra-violet ray sterilizers on the lake boats, which the writer has inspected, were of the pressure type, most of them operating on 220 volts direct current. Special motor-generator units are necessary for these sterilizers in order to insure a uniform voltage. It is of great importance that the voltage across the lamp be maintained at about 280 volts, or else the efficiency of the lamp in emitting ultra-violet rays will be reduced. In the original installation of this type of sterilizer, as approved for use on vessels, automatic lamp-tilting devices were installed with each outfit, but experience in the use of this automatic mechanism has justified its abandonment in favor of a hand lamp-tilting arrangement. The sudden closing of the automatic lamp tilter caused the mercury to flow quickly into the bowl of the lamp, where the impact was often too great a strain for the quartz to stand, and as a result breaking and loss of vacuum in lamps were not an infrequent occurrence.

Thermostatically controlled valves opened and closed by hydraulic pressure, regulate the operation of the steam ejector process of disinfecting water by heat treatment. By means of this control, no water is supposed to discharge to the sterilized water storage tanks, until it has first been heated to a temperature of 212°–220° F. and retained within that range of temperature for approximately three minutes. In one of the passenger boats, last season, a coil in the cooling tank leaked and permitted contamination of the disinfected water by water from the lakes. No arrangement for checking the operation of the valves at the rated temperatures was provided with any of these apparatuses, and subsequent tests of same on five vessels showed that all such valves were out of adjustment.

In discussing the above features relative to the conditions and practices in operation, under which water is supplied for drinking and culinary purposes aboard vessels plying on the Great Lakes, it is not the intention of the writer to convey the impression that the water treatment apparatuses are not sufficient, when properly operated, but the writer wishes to emphasize the fact that careful and intelligent operation of the same has not been practiced, in many cases in the past, especially on those vessels which were not under the supervision of health authorities.

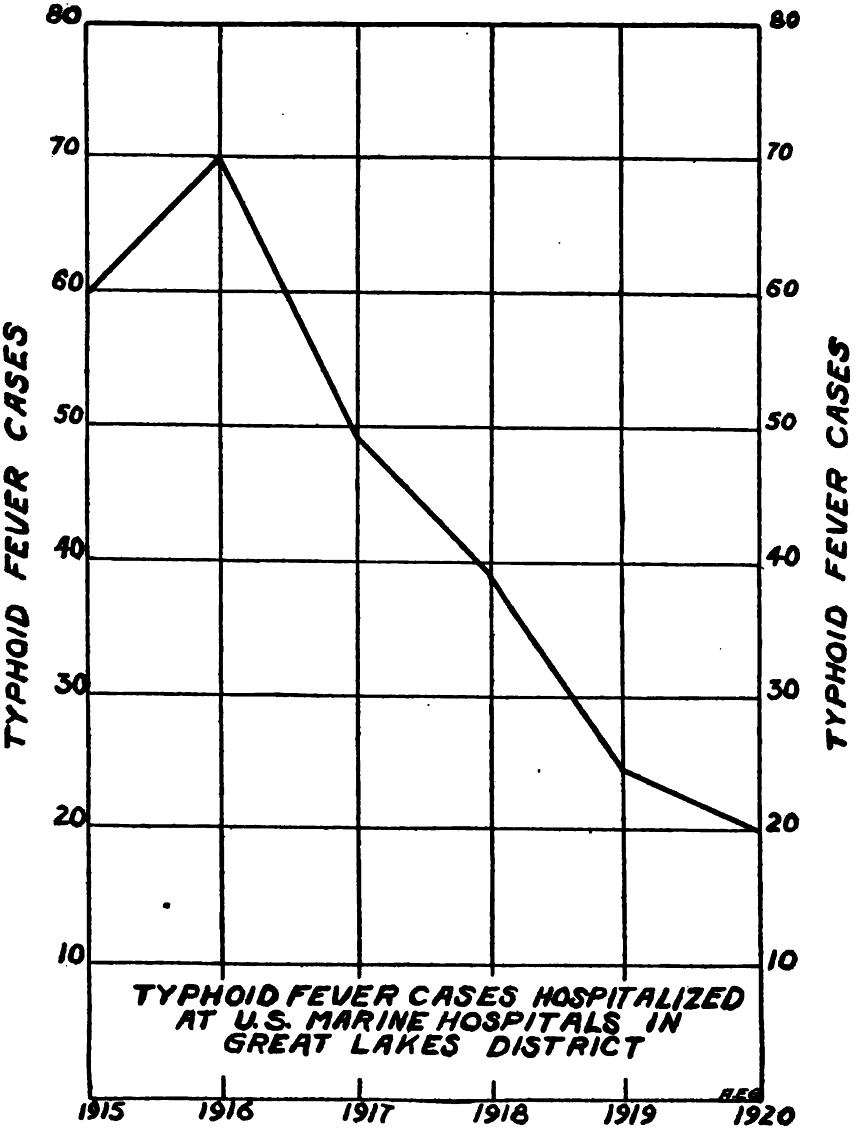


FIG. 6.

The following table showing the conformity to the Treasury Department bacteriological standard—for water used for drinking and culinary purposes on vehicles operating in interstate traffic—by samples of water taken from aboard passenger vessels calling at Detroit during the navigation season of 1920, was compiled from data kindly supplied by Mr. W. F. Walker, deputy commissioner, Detroit Department of Health:

Source or treatment.	Conformity to Treasury Department standard.								
	Samples.	Count 37° C.	Per cent.	Samples.	B. Coli per 100 c. c.	Per cent.	Samples.	Both.	Per cent.
R. U. V[1]	189	177	93.4	154	122	79.3	154	110	71.4
St. Ej.[2]	107	53	49.5	86	35	40.7	84	34	40.5
Still[3]	5	3	60.0	4	4	100.0	3	2	66.7
City water[4]	12	12	100.0	10	8	80.0	10	8	80.0

[1] 14 vessels, filtration and ultra violet ray sterilization.
[2] 5 vessels, heat treatment by steam ejector.
[3] 1 vessel, distillation.
[4] 1 vessel, city of Detroit water supply.

Even though the supervision and control over the conditions under which drinking water is supplied on lake vessels has been limited in the four years since the regulations requiring the treating of lake water aboard became effective, and although it is known that in many instances these apparatuses were carelessly operated and in others not operated at all, nevertheless, there has been a decided drop in the number of typhoid fever cases among Great Lakes seamen hospitalized at United States marine hospitals in these years, as is shown in the following table and the accompanying chart:

Typhoid fever among seamen reported by marine hospitals.

City.	State.	1915		1916		1917		1918		1919		1920		Total.	
		Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
Ashtabula	Ohio	1	....	1	....	1	....	1	....	....	....	....	....	4	....
Ashland	Wisconsin	....	....	1	....	1	....	1	....	1	....	....	....	4	....
Bay City	Michigan	....	....	1	....	....	....	....	....	....	....	....	....	1	....
Buffalo	New York	12	....	10	....	12	2	6	1	2	....	5	....	47	3
Cleveland	Ohio	10	....	4	1	4	1	4	....	3	....	2	....	27	2
Chicago	Illinois	6	....	13	....	1	....	4	....	....	....	2	....	26	....
Detroit	Michigan	12	....	14	....	8	....	10	....	12	2	....	....	56	2
Duluth	Minnesota	1	....	....	....	....	....	....	....	....	....	2	....	3	....
Erie	Pennsylvania	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Green Bay	Wisconsin	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Ludington	Michigan	1	....	....	....	2	....	3	1	....	....	....	....	6	1
Manitowoc	do	2	....	6	....	4	1	1	....	1	....	2	....	16	1
Milwaukee	Wisconsin	10	....	10	....	5	1	....	....	1	....	5	....	31	1
Port Huron	Michigan	....	....	....	....	2	....	....	....	....	....	....	....	2	....
Sandusky	Ohio	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Saginaw	Michigan	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Sault Ste. Marie	do	4	....	7	....	9	1	6	....	2	....	2	....	30	1
Superior	Wisconsin	1	....	3	....	....	....	3	....	2	....	....	....	9	....
Toledo	Ohio	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Total		60	....	70	1	49	6	39	2	24	2	20	....	262	11

It is undoubtedly true that the excellent work of such bodies as the Lake Carrier's Association welfare committee and the general publicity given to the danger in connection with the drinking of untreated lake water on vessels had their influence in the reduction of these cases of typhoid fever among seamen, but at the same time, following,. as it did, promptly after the installation of treatment apparatus on 65.2 per cent of all the American vessels plying on these lakes, the influence and effectiveness of the Federal regulations in this reduction is plainly apparent.

Prior to 1917, when the Federal laws were enacted, regulating the use of drinking water supplied passengers and crews on Great Lakes vessels, the number of typhoid fever cases among seamen hospitalized at United States marine hospitals in the lake district increased year by year, more or less in accordance with the development of the merchant marine. In 1875 there were 27 cases so hospitalized, with 5 deaths. The number of cases increased gradually year by year, until in 1890, 119 cases, with 8 deaths were reported during that year. For the decade, 1890–1900, inclusive, there was an average of 102 cases, with 9 deaths among Great Lakes seamen. In the next five years, 1901–1905, the average was 156 cases and 11 deaths. The years 1903 and 1904, respectively, were especially heavy typhoid years, 185 cases with 17 deaths and 174 cases with 11 deaths being reported for these respective years.

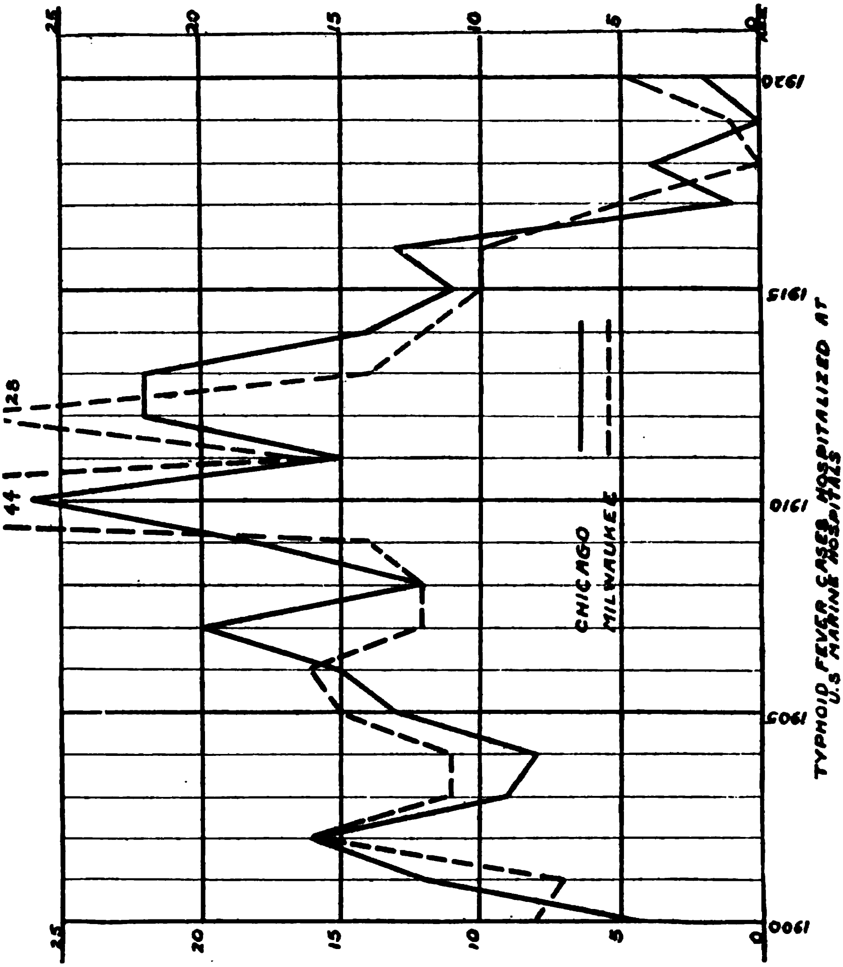
In 1913 and 1914 the epidemics on the steamships *Rochester*, *Huron*, and *Gopher* occurred, and during these years the peak in the typhoid fever curve was probably reached, although the complete returns have not been tabulated.

Since 1917 the drop in the typhoid fever rate has been very marked, as is shown in the accompanying graph. It is not improbable that the large number of typhoid inoculations given seamen who served in the Army or Navy during the war contributed to this reduction in cases; in fact, the rise in the curve for the period 1919–20 is quite significant that there was some such influencing factor affecting this disease during the two previous years.

However, it is very significant and encouraging to note that in 1920 there were fewer cases of typhoid fever among seamen received at United States marine hospitals in the Great Lakes district than there were in 1875, while the shipping on these inland waters was in its infancy.

The Chicago and Milwaukee curves shown for the 21 years, 1900 to 1920, inclusive, are interesting as illustrating the wide and abrupt fluctuations in the typhoid-fever cases reported during the years 1900 to 1916, and the reduction in cases since water treatment apparatuses were installed on vessels. The rise in the curve representing the 1920 typhoid-fever cases is also significant.

Of the 132 cases of typhoid fever reported from members of the crew of 102 different vessels, by the United States marine hospitals in the Great Lakes district, since the opening of the 1917 navigation season, information is available relative to the treatment of the drinking-water supply on vessels from among whose crews 112 of these cases are registered. The following table gives the number of typhoid-fever cases reported during these years and the source or treatment of the water supply used aboard the vessels:



TYPHOID FEVER CASES HOSPITALIZED AT U.S MARINE HOSPITALS

FIG. 7.

Type of vessel and treatment.	1917	1918	1919	1920	Total.
Freight:					
Still	25	24	9	13	71
Lake	2	2		2	6
Passenger:					
R. U. V	8	1	2	1	12
Still	2	2	1		5
St. ejector	1				1
City water	1		1		2
Car ferry:					
Still		2		2	4
Lake	3	1			4
United States Government:[1]					
Lighthouse tender	1			1	2
Dredge	1	2			3
Navy			2		2
Unknown	5	5	9	1	20
Total	49	39	24	20	132

[1] United States Government vessels, water either obtained ashore or taken direct from lakes.

In the year 1917 two cases of typhoid fever were reported from the same vessel, in three instances—twice from freighters and once from a passenger vessel—all having treatment apparatus aboard for sterilizing drinking water. Since that year, there has been a repetition of cases among seamen on no freight or passenger vessels on which the water was treated aboard. In 1918 a car ferry having a still aboard for distilling drinking water had two cases of typhoid fever from among members of its crew, while in 1919 a Navy vessel and a privately owned dredge had two cases each among their respective crews. No repeated cases were reported in 1920. In contrast to this record of the last three years, that of 1915 is cited, when two freighters, a tug and a car ferry, had two cases of typhoid fever each among members of their respective crews, while one Navy vessel had four such cases.

In the four years, 1917 to 1920, inclusive, eight freighters, four passenger vessels, and two car ferries, having treatment apparatus aboard for drinking water, had two cases of typhoid fever each among members of their crews. Two cases have also been reported during these four years from a passenger vessel using city water for drinking purposes, as well as the Navy vessel and dredge mentioned above.

In order to appreciate the relative importance of typhoid fever among seamen in connection with the public health, it is necessary to know something of the number of seamen employed on the Great Lakes and also the number of passengers traveling on lake vessels. It must always be borne in mind, in referring to the records of typhoid fever among seamen as reported by marine hospitals, that many of the seamen with families living in the Great Lakes district do not go to these hospitals for treatment.

The average size crew on the lake bulk freighters is about 30 men, on the car ferries, including "blockers," from 40 to 50 men, and on the barges from 8 to 10 men. The turnover in labor among Great Lakes seamen in a season is about 20 per cent. Using these figures as a basis, there are about 18,000 seamen employed on the lakes each season in freight traffic. The average navigating season on these lakes is from March 15 to December, or 240 days.

The seamen employed on American passenger vessels plying the Great Lakes in a season, assuming a 20 per cent turnover in labor, is estimated at 5,000. The navigation season for passenger service is quite variable, depending on the season and the traffic catered to. Some few vessels of this class operate all year round, others at regular seasons from May 15 to November 15, while those vessels in excursion service run during the two or three summer months only.

In 1920 the number of passages taken on the large vessels of the Great Lakes was about 13,870,000. It is believed that 16,000,000 would be a conservative estimate if the passages taken on all ferry and excursion vessels were added to this figure. About 9,500,000 one-way passages taken on ferries across the river at Detroit are included in the 1920 figures given above, on which vessels no water was supplied for drinking, and which of course should not be considered in connection with the control of water supplies on ships.

Of the 4,370,000 passages known to have been taken on Great Lakes vessels last season, 2,450,000 were on ships supplied with water treated aboard for drinking and cooking purposes, while 1,920,000 were on vessels for which this water supply was obtained ashore.

On April 15, 1921, regulations relative to water furnished for drinking and culinary purposes on vessels operating in interstate traffic or between foreign ports on or adjacent to the frontiers of the United States and adjacent ports in the United States became effective. These regulations are quite similar to those effective for Great Lakes shipping in 1917, but certificates of inspection are required for the water system aboard vessels as well as for the sources of supply ashore. Favorable certificates of inspection will not be issued for a vessel unless all by-passes around water treatment apparatus and cross connections between the drinking water supply system and any other water system on the ship are removed. A physical break in the line, made by removing a short section of pipe and plugging the two ends, is being insisted on in the Great Lakes district for elimination of by-pass and cross-connection piping on ships. It is being recommended that the pipes in the engine room and throughout the ship through which the drinking water is supplied be painted white to distinguish them from all other piping; and also that the section removed from the by-pass line be painted red and mounted on the wall or on a special panel against a white background, so that it will be conveniently available for use in emergencies, but always a reminder that its use is dangerous. Emergency measures for sterilizing all water used for drinking purposes while the by-passes are in operation during emergencies must be taken and a full report of the use of the by-pass and precautionary measures must be reported to the headquarters of the Great Lakes sanitary district. A record must be kept in the ship's log as to the time and location in the lakes at which the drinking water supply tanks were filled. Lead piping in the drinking water distributing system is forbidden because of the number of ships on which distilled water is provided. Water other than that certified for use for drinking and culinary purposes is not permitted in the galley.

Where drinking water is supplied vessels from a source ashore, it is being required that a separate hose or pails be used for delivering this water to the ship. If two kinds of water, one from the harbor for fire purposes and the other city water, are available at the wharf at which the vessel docks, it is being insisted on that the hydrant, from which the ship's drinking water is obtained, be painted white and properly posted with a sign. A recommendation is also made that the other hydrants on the wharf at which the harbor water may be obtained be painted red, as a precautionary measure against their use for supplying drinking water.

The Canadian authorities have adopted practically in their entirety the United States regulations, effective in 1918, relative to drinking water on vessels operating on the Great Lakes and inland waters between Canadian ports and ports in the United States. The following table of Canadian vessels was compiled from the 1920 directory of the Great Lakes Ship Master's Association and includes vessels operating on the St. Lawrence River and canals, as well as on the Great Lakes:

Type of vessel.	300 gross tonnage or under.	Over 300 gross tonnage.	Total.
Passenger	62	71	133
Freight	11	121	132
Barges	38	80	118
Carferries		10	10
Total	111	282	393

For exercising supervision and control over the water supply on Great Lakes vessels this season, the Great Lakes sanitary district has enlisted the cooperation of the shipping interests and the local health authorities. At Chicago where the headquarters for this district are located at United States Marine Hospital No. 5, a water laboratory has been equipped, and an inspector takes samples of water from the ships at dock each day. By arrangement with the city health departments at Buffalo, Chicago, Cleveland, Detroit, and Milwaukee, samples will be taken from the passenger vessels calling at these ports, on two or three days each week by a sanitary inspector and analyzed at the city laboratories. It is hoped that similar arrangements can be made for Toledo, Ohio, and Duluth, Minn. Weekly reports of the results of these analyses will be mailed to the headquarters of the Great Lakes sanitary district for record and each month the shipping companies will be informed of the results of analyses of samples of water taken from their respective vessels. In this way, it is believed that a willing spirit of cooperation between all parties concerned in the interest and health of the traveling public will be developed.

The report of the committee on certification of interstate carrier waters was read and discussed, and approved with modifications as follows:

REPORT OF COMMITTEE ON CERTIFICATION OF INTERSTATE CARRIER WATERS.

In the light of experience gained in the administration of the cooperative certification policy between State health departments and the United States Public Health Service during the past two years, in which period various related matters have come up for consideration, it is believed advisable that certain action be taken to clarify the principles of this policy and to make this policy more effective. It is, therefore, recommended:

1. If a water supply has been found unsafe by a State health department and disapproved to the city and improvements recommended by the department to insure the safety of the supply, the use of such water supply by a common carrier for drinking and culinary purposes in interstate traffic should be prohibited.
2. Placards stating that the use of an unsatisfactory water is forbidden should specify the governmental body condemning the supply, either the State health department alone, or in cooperation with the United States Public Health Service as the State may deem advisable, and should be posted over taps at stations through the State health department.
3. The policy concerning certification of vessel waters and vessel water systems should be adopted.
4. The methods of handling water from the supply to the delivery to the consumer on common carriers in interstate traffic should be supervised through the cooperation of the State health departments and the United States Public Health Service.
5. A committee of this conference should be appointed to consider various matters relating to this policy as they come up in the future.

Afternoon Session, June 2, 1921.

The conference reconvened at 1.30 p. m., Mr. Whittaker presiding.

A nominating committee was appointed consisting of Mr. Gage, chairman, Mr. Tisdale and Mr. Pincus.

Mr. C. A. Emerson, jr., submitted the following report:

REPORT OF COMMITTEE ON MILK SUPPLIES.

Those interested in the milk problem of to-day frequently inquire why the sanitary engineering profession has not taken a more direct part in the solution of the many perplexities of an engineering nature which surround the production, treatment and distribution of milk and milk products. Doubtless no other problem of health and convenience presents so large a field for the varied activities of the engineering profession.

Those already devoting their attention to this work are the agriculturist, the veterinarian, the bacteriologist, the chemist, the structural, mechanical, and refrigerating engineer, the health officer, the physician, the nutritionist, and the financier. All of these are assisting in the solution of some particular phase of the problem. Someone should correlate the facts at hand, anticipate the needs of the future, and act as a clearing house for those already engaged in the milk business—and who is better fitted for this duty than the sanitary engineer?

Have we to-day the best design for a dairy barn, silo, stable, stanchion, milk pail, milk can, milking machine, milk pipe, milk bottle, bottle washer, can washer, and delivery wagon? Are we properly constructing, screening, ventilating and lighting our milk plants? What is clean, safe milk? What does it cost and what should it cost to produce, transport, pasteurize, cool, bottle and deliver a quart of milk? Many of these questions are now before us unanswered. The committee feels, however, that our present consideration should deal with fundamentals upon which may be built a future structure containing more detail.

There are regulations which are national in application, others should be assumed by the State, and others are of a purely local nature. The regulations of none are well established at this time. We are convinced that regulations of any kind must begin with present conditions and build a progressive policy, keeping in mind the finances of the problem as well as the quality of the supply. We are dealing with a food which is almost universal in use and national efforts are being made both by the producer and the distributor to materially increase milk consumption.

Regulations necessary to care for general market conditions may be grouped as follows:

First. Milk shall have food value to be useful.

Second. Milk shall be safe to prevent disease.

Third. Milk shall be clean to observe decency.

Fourth. Milk shall have keeping quality to be satisfactory.

Fifth. Milk shall be fair in price to assure production and consumption.

There are five distinct advancements which this committee wishes to recognize:

First. The accredited herd plan, as promoted by the Bureau of Animal Industry, United States Department of Agriculture, and similar bureaus in 46 States. By this plan we have herds known to be free from bovine tuberculosis, and thus a raw milk is obtained which can not transmit bovine tuberculosis to the consumer.

Second. Certified milk, when it is the product of dairies operated in accordance with the "Methods and standards for the production and distribution of certified milk" adopted by the American Association of Medical Milk Commissions. A few boards of health, corporations, and individuals are now certifying milk. Certified milk should conform to standards which are uniform throughout the Nation. The term, certified milk, should be limited to milk which has been certified by a medical-milk commission operating in accordance with the regulations of the American Association of Medical Milk Commissions.

Third. Standard methods for the bacteriological examination of milk, as adopted by the laboratory section of the American Public Health Association. These methods have been sanctioned by committees of the laboratory section of the American Public Health Association, American Dairy Science Association, International Association of Dairy and Milk Inspectors, and members of committees from the Society of American Bacteriologists and American Association of Medical Milk Commissions. The use of these methods for the bacteriological examination of milk gives comparable results, and this procedure should receive universal support and be national in character.

Fourth. Pasteurized milk is defined by the United States Department of Agriculture, in Food Inspection Decision No. 178, as "milk that has been subjected to a temperature not lower than 145° F. for not less than 30 minutes. Unless it is bottled hot, it is promptly cooled to 50° F. or lower."

The above definition was approved by the Association of American Dairy, Food, and Drug Officials and by the Association of Official Agricultural Chemists.

Practically the same definition of pasteurized milk is given by the committee on milk supply of the sanitary engineering section, American Public Health Association, which says: "The process of pasteurizing milk for human consumption should consist of subjecting the milk to a temperature not lower than 145° F. for not less than 30 minutes."

The definition of pasteurized milk should be national in character as far as heating and holding is concerned. Cooling affects the keeping quality rather than safety, and possibly the temperature to which milk should be cooled should not be included in the definition of the process of pasteurizing.

Fifth. At the present time various terms are used throughout the country to designate the different grades or kinds of milk being sold. Often an identical grade is described by different terms. A system of grading established and defined by the State or Nation would do much to protect the consumer against fraud, allow the consumer to purchase the kind of milk desired, and bring about a financial stimulus essential to the production of clean milk. The number of grades required would not exceed four or five in any case.

Your committee considers it the duty of the health official to designate the quality of milk a dairy farm should produce and permit the dairy interests, as far as possible, to select the methods and equipment necessary to attain such quality. This means that the health official will confine his attention to such methods and equipment as have a direct bearing upon the production of a milk supply free from transmissible disease. The dairy interests are attempting to develop their own supervision over methods and equipment at the dairy farm to such an extent that interference by the health official will be unnecessary, and by this way it is believed that considerable friction which has existed will eventually be overcome.

Consideration of some of the difficulties in regulating the food value of milk is worthy of the attention of this association.

Market conditions now require a milk treatment and delivery expense almost equal to the expense of production. The laws of several States require at least 3.25 per cent fat in the market milk, and a few have permitted the sale of 3 per cent milk when delivered by the producer. The agitation for a low butter fat content has been largely promoted by the producer, because he has found it feasible to breed herds giving milk of a low fat content at probably a less expense to him. But, on the other hand, the consumer desires, and in many cases demands, a milk containing at least 3.5 per cent butter fat. Why then should not the milk produced be nearer to that which is required by the consumer. The State law in many cases prohibits changing the fat content in the milk after delivery from the dairy farm. This is not a vicious practice. If standardization is legalized and the producer encouraged in the production of milk containing at least 3.5 per cent butter fat, it is the belief of the committee that a more just and satisfactory condition will be brought about.

A motion was made, seconded and approved to adopt the above report.

Mr. H. A. Whittaker presented the following paper:

THE SUPERVISION OF MILK PASTEURIZATION IN MINNESOTA.

The State board of health, in 1917, authorized an investigation of conditions relating to pasteurized milk used for human consumption throughout the State. The division of sanitation was selected to undertake the major part of this investigation because it was equipped with the engineering and laboratory facilities necessary for carrying on such work. At that time there were about 50 pasteurization plants in operation in the State. Milk was labeled and sold as pasteurized milk in all but seven cities with a population of 5,000 or more, and in these cities it represented from 50 to 90 per cent of the entire supply. Investigations were made at 32 plants, and in practically every instance the pasteurization of milk as carried on at that time had little, if any, value from a health point of view. Five plants were found labeling their product "pasteurized milk" when they did not own any pasteurizing apparatus.

The detailed investigation at each pasteurization plant, conducted during this survey, included a study of the building in which the plant was housed; the plant equipment, involving a careful examination for mechanical defects; and the efficiency of the process in accomplishing satisfactory pasteurization of the milk as determined by analytical examinations of the milk before pasteurization and during the various steps in the process. A careful study was also made of the methods of operation in use at each plant. Information was also collected relative to the supervision exercised by local authorities in the various communities in which these plants were located.

The investigation of the buildings in which the various plants were housed revealed the fact that the buildings were improperly planned and constructed for housing pasteurizing apparatus and other milk-plant equipment. Some of these buildings were improperly lighted and ventilated; had floors and walls constructed of material or in such a manner that they could not easily be cleaned; had unsafe or inadequate water supplies; had unsatisfactory sewage and waste disposal facilities; lacked toilet and lavatory facilities, and were not effectively screened against flies.

The study of the pasteurizing apparatus in use at the various plants brought out the fact that much of the equipment was incorrectly designed and constructed for the purpose of pasteurizing milk for human consumption, and that it was oftentimes arranged in an insanitary and impractical way. Many mechanical defects were found in the apparatus which could be eliminated, thereby insuring a safer product from a health point of view. These defects included mechanical difficulties in heating the milk to a proper temperature, in holding it at the required temperature for a sufficient length of time, in preventing the contamination of the treated or partially treated product at some step in the process with raw milk, partially treated milk, or with other contamination introduced from some external source during the treatment or to the finished product.

In addition to the unsatisfactory conditions associated with the housing of these plants and their equipment it was found that many operators did not understand the purpose of pasteurization, the principles involved in the process, or the methods of operating and caring for pasteurizing apparatus. The employees at the plants were not given a medical examination to determine whether they were chronic carriers of infectious diseases.

This investigation revealed the fact that the control of pasteurization, and the subsequent handling of the finished product, was almost negligible at that time; the State had no law or regulation governing pasteurization, and only a few municipalities had local ordinances which gave them authority over the distribution of this class of milk.

To summarize briefly the results of these investigations, it was found that the pasteurization of milk throughout the State, as conducted at that time, meant practically nothing from a health point of view. It was practiced largely to improve the keeping quality of the milk and for advertising purposes. This condition should not be charged entirely against the milk dealers, for the State had not then laid down any requirements for the pasteurization of milk, and only a few municipalities had realized the importance of establishing local control. The continuation of this condition would eventually have resulted in the loss of public confidence in the process as a health measure in the State.

With this information available, the State board of health decided that if the process of pasteurization as applied to milk for human consumption was to have any value as a safeguard against disease, some method of control must be adopted, and as a result the following steps have been taken to improve the unsatisfactory conditions which were found to exist.

In order to establish a uniform requirement for the pasteurization of milk throughout the State, a regulation was passed by the State board of health defining pasteurization and requiring the approval of plans and specifications on all new installations, or changes in existing installations, of pasteurizing apparatus. General requirements governing the construction and operation of pasteurization plants were outlined, which established a uniform basis for the enforcement of this regulation.

The fact that the plant owners and operators did not always understand the purpose of pasteurization as a protection against disease, the principles involved in the process, or the methods of operation and care of their pasteurizing apparatus, demonstrated the need for establishing some course of training for educating these people. Arrangements were made with the division of dairy husbandry of the department of agriculture, University of Minnesota, to give a course for training plant operators, in cooperation with the State board of health.

To further the establishment of local control of pasteurized milk and its subsequent handling in municipalities in the State, a proposed milk ordinance was drafted and approved by all departments of the State government interested in the local control of milk supplies. This ordinance is adaptable to cities in the State not in Class I, which would include all cities except Minneapolis, St. Paul, and Duluth. The requirements of this ordinance governing pasteurization conform with the regulations of the State board of health.

As a result of these efforts to establish supervision of pasteurization in the State, pasteurization plants have been investigated and recommendations made for correcting defects in construction and operation in all plants where it was found to be necessary. These recommendations have been carried out in all plants under the jurisdiction of the State board of health, or the plants have been requested to discontinue labeling their products "pasteurized milk." Follow-up investigations are being made at irregular intervals to determine whether the plants are being operated in a satisfactory manner and to assist the authorities where local control has been established.

Plans of new pasteurization plants are being examined and approved in accordance with the detail procedure established for carrying out the regulations of the State Board of Health.

Provision has been made for the medical examination of employees who are engaged in the pasteurization or bottling of milk, or in the cleaning or sterilizing of milk apparatus and utensils at the plant, in an effort to locate chronic carriers of infectious diseases. This work is done under the direction of the division of preventable diseases of the State board of health.

Short courses for pasteurization plant owners and operators have been given at the University of Minnesota for the past two years. These courses have consisted of lectures, demonstrations, and visits to pasteurization plants, including briefly the study of the process of pasteurization as a health measure, the important essentials in the construction and operation of pasteurizing apparatus, and general practical milk plant problems. These courses have been well attended and have resulted in an apparent improvement in the personnel of pasteurization plants throughout the State.

A campaign has been carried on to encourage municipalities to pass the proposed milk ordinance approved by the various State departments, which establishes local control of the milk supplies under State supervision. Talks and illustrated lectures before interested organizations, and city and village councils, have proved a very effective way of accomplishing results. The results of this work may be understood when it is appreciated that only two cities in the State, exclusive of cities in class I, had effective local supervision when this work began, while at the present time the proposed ordinance has been passed and is in force in 50 per cent of the cities in the State with a population of 5,000 or over (27 over 5,000 population).

The success which has been obtained in Minnesota in the improvement of the pasteurization of milk from a health point of view may be attributed to a number of reasons, the most important of which are: (1) The initial survey which provided information concerning the existing status of pasteurization in Minnesota, and formed an intelligent basis for action, (2) the carefully worked-out plan for correcting the unsatisfactory conditions which were found, and (3) the cooperation which was received from all parties concerned, including municipal officials, local organizations interested in this problem, and the milk dealers.

Mr. J. Frederick Jackson spoke as follows:

STATE CONTROL OF STREAM POLLUTION AND SEWAGE DISPOSAL IN CONNECTICUT.

State control in Connecticut emanates from that authority which is vested in a special commission or some executive department by legislative act and which it may exercise within certain limitations, and the restraint or pollution which proceeds from judicial action in response to claim of invasion of the rights of the individual citizen under common law statutes. Control of the latter class, Connecticut has exercised since about the middle of the nineteenth century. Her statutes have gone farther than the legislation of most States, and decisions of her courts have served as precedents for other States when considering questions of stream pollution.

Control by special legislation has been in force in Connecticut only since 1915, when the present statutes were enacted. These placed the administration with the State department of health and authorized it to investigate pollution of streams, sewerage systems, and sewage and refuse disposal works, and require for the latter efficient operation or order their alteration or replacement, if deemed necessary for the protection of public health. They also required the approval of the department for all plans for new sewerage systems and disposal works before construction. Action by the department was limited to pollution which was prejudicial to public health. In 1917, a later act created an industrial wastes board to cooperate with the department of health in studying the pollution by factory waste.

The area of the State is about 5,000 square miles and drainage basins of the three largest rivers—the Housatonic, Connecticut, and Thames—constitute about 78 per cent of this area. Lakes, swamps, and salt marsh cover about 154 square miles.

Of the 168 towns, 61 are partially or wholly sewered and 19 towns treat their sewage. The method of treatment varies, but intermittent sand filtration is most common.

In investigations of stream pollution, we must consider surface and underground waters; intra and inter state, navigable and non-navigable rivers; streams used as a source of potable supply; streams dedicated to fishing or industrial use. In Connecticut we must also consider the estuaries and waters of Long Island Sound.

Former investigations include a survey several years ago of most of the potable water supplies of the State by Profs. Williston and Smith and a survey by the old State board of health in 1914, by special direction of the general assembly, of most of the important streams of the State. Conditions shown by this last survey were instrumental in securing the passage of the acts of 1915.

Prior to the organization of the present department of health in 1917, there was practically no supervision over sewerage works. Since that time with a limited personnel and appropriation, our efforts have been confined to obtaining a correct list of the sewerage systems and sewage-disposal works existing in the State and to educating those responsible, in some methodical schedule of operation and maintenance. Since the organization of the State department and of the passage of the acts of 1915, 47 approvals have been granted for sewerage works.

The whole question of State control, as we view it in Connecticut, means a campaign in educating the people in the benefits and desirability of properly designed sewerage systems and efficiently operated sewage-disposal works. To convince people, who for years have been using the nearest water course as the natural method of disposing of their wastes, of the necessity of treating their sewage before discharge is a long and often discouraging task and calls for the exercise of great patience, diplomacy, and persistency.

The improvement in the six years that this work has been under way, though much still remains to be accomplished, is distinctly encouraging. There has, as yet, been no test case of the authority granted to the department under the statutes. There is a wholesome respect as a result of the decisions rendered against the cities of Waterbury, New Britain, and Danbury under the common law which leads most of the municipalities, who are violators, to adopt a receptive attitude, and makes them willing to at least listen to suggestions toward removing their pollution from the streams.

For over 10 years there has been a very strong public sentiment in the State against the continuance of the present pollution and it showed itself very strongly in 1915 when the present statutes were enacted. This year it was particularly strong and an act to eliminate all stream pollution by industrial wastes before 1926 was proposed. This bill was supported largely by the shellfish and finny fish industries who have seen the oyster industry in the harbors along the coast and Long Island Sound and the shad and salmon fishing in the Thames, Connecticut, Housatonic, and other streams disappear.

While control of stream pollution is under two bodies—the Department of Health and Industrial Wastes Board—actually they function as one. The method of operation is as follows: All complaints are investigated by the commissioner of health who acts as chairman of the joint board. If investigation shows pollution is caused by industrial wastes and is sufficiently important, then the problem is referred to the Industrial Wastes Board for complete investigation and report. The Industrial Wastes Board has no authority to issue orders to stop pollution, and action by the department of health, as has been stated before, is limited to pollution prejudicial to public health.

The work of the industrial wastes board has been confined to an intensive study of the Naugatuck and Hockanum Rivers, silk-mill wastes at South Manchester, iron wastes at New Britain, and wastes from wood distillation at East Canaan, together with preliminary surveys of several other streams in the State. The results of these investigations were quite interesting. Time does not permit us to discuss them fully, but some of the more important were: Limits of impurity; effect of copper, zinc, and iron waste on bacteria; failure of criteria of dissolved oxygen and dissolved oxygen demand in presence of these wastes; treatment of wastes at source *v.* treatment at one disposal works; limits of equalization of flow from storage reservoirs; limits of theory of stream flow per contributing population.

There are 19 municipal disposal plants in the State—2 digestion (followed by sand filtration), 4 Imhoff tank and disinfection, 2 septic tanks, 1 sand filtration and broad irrigation, and the other 10 some form of sand filtration. At practically all of these, with the exception of the three mentioned below, operation is not satisfactory. Of the municipalities located on the sound, Greenwich treats its sewage by Imhoff tanks; Stamford has a plant practically complete for treating its sewage the same way; Bridgeport is installing a screening plant to take care of the sewage from the west side of the city and later expects to install another screening plant to take care of that from the east side; New Haven disposes of its sewage in the harbor untreated, but is considering treating it by the Miles acid process; New London, with the great volume of water in its harbor, disposes from submerged outlets 800 feet off shore; the remainder of the small towns, such as Westport and Norwalk, which have sewerage systems, dispose of their sewage untreated either into the river or harbor.

Of the inland cities on the larger rivers, Hartford on the Connecticut, Willimantic on the Willimantic, Putnam on the Quinnebaug, Torrington, Thomaston, Waterbury, Naugatuck, Ansonia on the Naugatuck, and New Milford, Birmingham, Shelton, and Derby on the Housatonic, discharge their sewage untreated into the streams. State institutions, where they are not connected to the public sewer system, and with the exception of the State Hospital for the Insane at Norwich on the Thames River, and the State's prison at Wethersfield on the Connecticut, all have some method of treatment though in the majority of cases, the operation has been so neglected that little or no purification is effected. At the 36 shore resorts scattered along the edge of the Sound no attempt is made to treat the sewage, except at Sound Beach, Woodmont, and Groton Long Point. Disposal in general is by means of outside privies or where water-flush toilets are installed, leaching cesspools, or septic tanks. At the 65 camps of more or less permanent character in the State, with the exception of one or two, the method of disposal is by outside privies.

Connecticut has probably three of the oldest and most successful intermittent sand filtration plants in the country, those at Meriden, Bristol, and Danbury. The plant at Meriden was built in 1892 the city acquiring about 145 acres of land for this purpose. It consists of 11 acres of beds for treatment of dry-weather flow with two additional to take care of the storm water. The site is particularly favorable, the sand deposit being over 30 feet deep and ground water level 16 feet from the surface. Average volume of sewage treated in 1920 was 3.9 million gallons and operating cost $9.17 per million gallons. The plant in Bristol was built in 1895. The city owns 83½ acres and there are about 11 acres of built-up beds. They are treating about 2 million gallons per day at a cost of about $14 per million gallons. The plant in Danbury was built in 1897 and consists of 10 acres of sand beds and 10 acres of broad irrigation. The volume of sewage treated is about 3 million gallons per day and cost $5.61 per million gallons.

Meriden and Bristol showed unusual foresight in providing ample areas of land and are insured against any trouble for many years to come. The effluents from all three plants are good and per cent removal uniformly high. Bristol had some trouble from clogging of the beds which they attributed to iron wastes, but which was more likely due to overloading and to practice of plowing beds deeply which caused the overturned surface mat to form an impermeable strata about 12 to 16 inches below the surface.

The experience with these plants is very different from that at New Britain where iron pickling liquors have so affected the beds, the area of which was admittedly too small and their character unsuitable so as almost to put them out of use, and at South Manchester where, though the sand was satisfactory, the area was not nearly large enough, and wastes from silk mills have completely clogged the beds. At New Britain the dosage was about 143,000 gallons per acre per day and South Manchester 350,000 gallons.

In Connecticut no rivers grossly polluted are used as a source of water supply. Present statutes give sufficient authority to the department to protect streams used as a source of water supply and control of these is tolerably easy where minor nuisances occur. We have no cases where streams used for disposal become entirely dry at certain seasons of the year, though in many of them the flow is greatly diminished. The stream pollution with which we are concerned at present is that affecting fishing, boating, bathing and pasturing of cattle. The control of this is difficult where proof of its being detrimental to public health is required.

The need of some change in the limitation of bond issues by the general asscmbly is very apparent and any great improvement in many of the towns will be delayed because they have already reached their limit of bonded indebtedness. The writer had occasion in appearing before the committee on finance to urge that in considering requests by towns to use bonds, sewerage systems should be placed in the same class as lighting, power, and water companies, but this argument did not seem to impress the committee very much.

One feature of our work that is interesting is the greater success in getting improvements made when dealing with corporations and individuals than when dealing with municipalities. In general, there appears to be less initiative and greater tendency to delay improvements on the part of the municipalities. They are rather content to let things rest as they are, conduct no research, nor make any plans for future development.

That the common law gives all authority necessary to control the pollution of streams is shown in the cases of Morgan *v.* Danbury, Platt Bros. *v.* Waterbury, Nolan *v.* New Britain. It places, however, the burden of proof and the expense of court procedure upon the individual riparian owner. Control by the State is at present limited to pollution which can be shown to be prejudicial to public health; though in case of water and ice supplies, considerable latitude is given to local health officers and the State department of health to control nuisances.

As we see it in Connecticut, power should be granted the State department to control violations against public welfare as well as public health. A system of reporting similar to that required from public utilities should be put in force and authorities should be educated to the fact that sewage disposal works must have just as careful operation and supervision as water works or other public utilities. Whether efficient supervision can be maintained by correspondence is doubtful. On the other hand, to exercise a close supervision and compel efficient operation with authority as at present would require so large an organization and expense as to be prohibitive. The retention of designers of plants as consulting engineers by municipalities would be desirable, but its recommendation by a State department is likely to raise suspicion of collusion. One carefully prepared and ably prosecuted case of violation will accomplish more than any amount of correspondence and inspection. Every riparian owner should be supported strongly when his property is affected by pollution, and if this is done their interest will be stimulated and their support for constructive legislation assured.

There have been two contradictory tendencies evident lately; one toward a general letting down of restrictions and regulations safeguarding health, coming from those who from their experience with the many governmental restrictions during the war now resent any attempt to control either their corporate or individual action; the other toward continuing and in some cases extending the supervision of the State over matters of this kind.

In Rhode Island the latter manifested itself in the passage of a rather drastic act concerning the pollution of rivers by industrial wastes, the nucleus of which was in defining pollution as that which is deleterious to fish and plant life. In Connecticut a similar bill had very strong support, but is was so strongly opposed by manufacturers and municipalities that it failed in committee. The committee reported that they were unable to frame any bill which would be fair to the manufacturers, the municipalities, and the State at large.

However, it is easy to discern a definite attitude toward stricter standards for effluent sand trade wastes. This should be considered by engineers engaged in health work and study and provision made to meet it. In this connection we might to-day very well ask ourselves: (1) Have we established satisfactory criteria for practical use, or have we been misdirecting our efforts in setting up limits and standards difficult, if not impossible, of application, and so indefinite in their determinations of the degree of pollution as to be practically useless in administering State control over stream pollution?

The success of control by a State department or commission depends on personnel and appropriation, natural features of the State, such as streams, lakes, etc., its area, character of its industries, whether it is a recently settled State or one which has been settled for a long time, and general attitude of mind of its citizens. The advisability of setting strict standards depends largely upon the value of the industries affected, and whether we are trying to protect the people against inconvenience from nuisance, or safeguarding public health, which must be protected at any cost. In considering pollution we must also take into account the accessibility of the stream to large centers of population and its effect upon their health when used for camps and recreation purposes.

For example, certain portions of our coast particularly suitable for sanitariums for crippled children must be strictly supervised. New industries should be forbidden to locate on streams suitable for camping and still containing fish life. Established industries on such streams should be required to treat their wastes so that they are not objectionable.

Finally, what we need in actual practice to-day is the simplest and least costly method of disposal for (1) dwellings, institutions, and camps not accessible to sewerage systems, and where a sufficiently large body of water for dilution is available or where the soil conditions are satisfactory; (2) most economical method of disposal for municipalities with existing sewerage systems, convenient to large bodies of water; (3) most economical disposal for municipalities with existing sewerage system, located on small bodies of water or with subsoil not suitable for disposal on land; (4) shore resorts with sewerage systems; (5) shore resorts without sewerage systems.

In this study each city and each locality in the State should be considered as a separate problem. Connecticut has its own particular problems and their treatment and solution may be such as would not be advisable in other sections of the country.

Mr. H. E. Miller, representing Mr. Ehlers, presented the following report.

PROGRESS REPORT OF COMMITTEE ON SEWAGE DISPOSAL AND STREAM POLLUTION.

INTRODUCTION.

By reason of the lateness of replies to questionnaires reaching the chairman of your committee and the limited time in which to study the various laws and regulations, our report to the association at this time must be confined to a brief summary of the data at hand.

RÉSUMÉ.

For your information we wish first to call your attention to the questionnaire form prepared by your committee and forwarded to the sanitary engineer of each State through Mr. I. W. Mendelsohn, district engineer, United States Public Health Service, Washington, D. C., and corresponding secretary for the conference of State Sanitary Engineers.

Considerable study was given to the preparation of a questionnaire with the object of securing pertinent information on the present status of State control of sewage and stream pollution, in condensed form, and still provide sufficient evidence for a comprehensive digest. Copies of laws and regulations were also requested, principally to determine what State agency is given jurisdiction with or without limitations and what machinery is provided.

Replies to the questionnaire were received from the following thirty-three States: Alabama, Arizona, California, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Missouri, Montana, New Jersey, New Mexico, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Vermont, Virginia, and West Virginia.

A résumé of these replies indicates that:

1. The following States have laws or some form of State board of health regulations relating to sewerage and sewage disposal:

Laws: California, Connecticut, Illinois, Indiana, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Montana, New Jersey, New Mexico, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, Texas, Vermont, and West Virginia.

No laws: Alabama, Arizona, Delaware, Florida, Georgia, Missouri, South Carolina, South Dakota, Tennessee, and Virginia.

2. From this list it is noted that 23 out of the 33 States listed have laws or regulations.

3. Practically many of the existing laws and regulations are not entirely satisfactory.

4. A large percentage of statutes are behind prevailing public opinion.

5. Twenty-one States of the 23 that have laws or regulations require examination of plans and 19 require that permits be issued before construction work can be started on sewer systems or disposal plants.

6. Specifications of the engineering division of each State listed, requiring submission of plans, are noted to be very general and intended only to be suggestive, leaving matters largely to the judgment of designing engineers.

7. Practically all engineering divisions depend on engineers' visits, inspections, and newspaper reports to be made aware of new projects.

8. Every State listed uses and prefers sanitary engineers operating from one central office, with the exception of Tennessee and Maryland.

9. Engineering divisions of the States listed make special efforts to stimulate the building of sewerage systems and sewage disposal plants excepting where lack of personnel prohibits.

10. The following list of States from those replying are found to be empowered to order improvements: Alabama, California, Kansas, Kentucky, Maryland, Mississippi, Montana, New Mexico, North Carolina, North Dakota, Oklahoma, Ohio, and South Carolina.

11. Very limited work has been undertaken to study the pollution of streams.

Among those recording investigations along this line are California, Connecticut, Indiana, Louisiana, Michigan, Missouri, Minnesota, Montana, New Jersey, New Mexico, Ohio, Pennsylvania, and Rhode Island.

12. Trade wastes are shown to vary in the different States. Progress in the handling of troublesome wastes is noted to be retarded, largely on account of funds and personnel.

13. States recording treatment of typical trade wastes are as follows:

(1) Ohio.—Pickling liquor producing sugar, copperas without liquid wastes.

(2) Louisiana.—Sugar factory wastes, dry broad irrigation.

(3) Illinois and Texas.—Being conducted on corn products wastes, not described.

(4) Kansas.—Oil refineries—waste held in reservoir and discharged according to flow of stream to give maximum dilution.

(5) West Virginia.—Tanneries by series of sedimentation basins, inefficient operation.

(6) Minnesota.—Dairy wastes by settling tanks.

(7) Connecticut.—Tannery wastes have screening, door-thickener, lagoon, dosing chamber, and sand bed. Just installed; good results anticipated.

(8) California.—Fruit and vegetable cannery waste by settling or fine screening, with final disposal by spreading on sandy land.

(9) Virginia.—Tannery wastes. Refers to report of Hommon on Luray tannery plant.

14. No definite policy seems to be adopted by any State regarding method of handling or disposal of troublesome wastes, although decided progress is being made in this field of controlling stream pollution.

15. Your committee further notes that where adequate laws exist and commensurate machinery is supplied, very satisfactory results are exhibited.

In some of the States where trade wastes are a considerable problem there are no facilities for making the desirable studies. The United States Health Service could render a valuable service if it could assist these States in solving this problem. The investigations that have been under way by the United States Public Health Service have been of great value, and should be extended in scope.

A motion was made, seconded, and adopted to accept this report as a progress report.

Mr. Allen spoke on "Ratproofing from an engineer's point of view."

Mr. E. H. Gage, representing Mr. Merser, submitted the following report:

COMMITTEE REPORT ON MOSQUITO CONTROL.

Following the annual meeting in Washington last year a committee was appointed to prepare a report on mosquito control. As a first step the committee decided to secure information from all the States by means of a questionnaire covering the following phases of the subject: (1) State organization, (2) appropriations, with amounts expended in municipalities and in rural districts, (3) laws and regulations, (4) morbidity reports and (5) remarks concerning the control methods which have proved most satisfactory.

Replies have been received from 36 of the 48 States or 75 per cent, which is a very gratifying response.

The information obtained has been summarized and is presented in the tables which follow, with explanatory notes where necessary.

TABLE I.

State.	Control work.		Special laws or regulations.	Reporting of malaria.			
	Yes or No.	Primary objects.		To State board.	Time allowed.	Reliability.	Approximate per cent.
Alabama	Yes	Malaria	Yes	Yes	Week	Doubtful	25
Arizona	No			Yes	Month	Poor	
Arkansas	Yes	Malaria	Yes	Yes	Week	Poor	Less 10.
California	Yes	Malaria	Yes	Yes		Poor	10
Connecticut	Yes	Mosquito	Yes	Yes		Poor	
Delaware	No			Yes	Day	Poor	Low.
Florida	Yes	Malaria	No	Yes	6 hours	Poor	10
Georgia	Yes	Malaria	No	Yes	Week	Poor	Less 10.
Idaho	No						
Illinois	No		No	Yes	Day	Poor	
Indiana	No			Yes			
Kansas	No						
Kentucky	Yes	Mosquito	No	Yes	Day	Poor	30–50
Louisiana	Yes	Malaria	No	Yes	*	Poor	*
Maryland	No			Yes	Day		
Michigan	No			No			
Minnesota	No		No	No			
Mississippi	Yes	Malaria	Yes	Yes	Month	Fair	50–75
Missouri	No		No	Yes	Week	Poor	
Montana	No			Yes			
New Hampshire	No		No	Yes		Good	
New Jersey	Yes	Mosquito	Yes	Yes			
New Mexico	Yes	Mosquito	No	Yes	Day	Poor	
North Carolina	Yes	Malaria	No	No			
North Dakota	No						
Ohio	No		No	Yes	2 days	Good	
Oklahoma	No						
Pennsylvania	Yes	Mosquito	Yes	Yes	*		*
Rhode Island	Yes	Mosquito	No	Yes			
South Carolina	Yes	Malaria	Yes	Yes	Month	Poor	
South Dakota	No						
Tennessee	Yes	Malaria	No	Yes			
Texas	Yes	Malaria	No	Just started.	Month	Poor	
Virginia	Yes	Malaria	No	Yes	Month	Poor	
West Virginia	No						
Wisconsin	No						

* Number not known.

From the above tables it is noted that mosquito control is being done in 18 of the 36 States, and in all of these except Connecticut, Kentucky, New Mexico, Rhode Island, New Jersey, and Pennsylvania the primary object is the reduction of malaria. In four of the States the work is not under the supervision of the State board of health but is being carried on by other departments as follows:

Connecticut: By the State agricultural station.

New Jersey: By State department of conservation and development.

Rhode Island: By local authorities only.

California: By the university agricultural experimental station.

In a number of States, Alabama, Arkansas, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia, the United States Public Health Service and International Health Board, or both, have entered into cooperative arrangements with the State boards and have furnished funds or personnel. Similar arrangements are now being made in the State of Missouri.

LAWS AND REGULATIONS.

Concerning special laws and regulations pertaining to mosquito control and particularly State supervision of impounded water, reclamation of wet lands, irrigation projects, and stream control, replies are summarized as follows:

Alabama.—Impounded water: Permit must be granted to impound any water. The law provides that when a dam is to be built a jury of 12 men is selected to fix the damages to the land and to determine whether impounding of water will or will not be injurious to the public health. The usual procedure is for the jury to call on the county board of health, which in turn calls on the State board to send an engineer for the purpose of making an investigation and to keep in touch with the proceedings until the jury report is made and confirmed by the court. So far the law has been very effective. The State highway department has included in specifications for State aid and Federal aid roads a clause requiring the contractor to drain or fill borrow pits which otherwise would constitute mosquito nuisances.

Arkansas.—The State highway department has special regulations in connection with drainage along improved highways.

California.—Drainage district: An act approved 1915, providing that districts having populations of 100 or more may be created for the abatement of mosquitoes. Under this act districts, including incorporated and unincorporated property or portions of both where mosquito control is desired, authorizes the taxation of landowners in that district to the extent (if necessary) of 10 cents on $100. The funds thus collected are used for the salary of an expert placed in charge of the work, labor, utensils, and permanent control measures.

Connecticut.—An act approved 1917, providing that director of the State agricultural experiment station may make rules and orders concerning elimination of mosquitoes and mosquito breeding places, for the appointment of deputies to supervise the work. This act was amended in 1919 as follows: Whenever any swamp, marsh, or other land has been drained, property owners shall keep same in repair and free from obstructions and construct or repair tide gates or otherwise treat such areas so as to make the work effective. The cost of maintenance or treatment, not exceeding $1 per acre per year, shall be paid by the State, and the town, city, or borough within which such place or area is located shall reimburse the State for three-fourths of the amount so expended. The act further provides for the appointment of one or more deputies to supervise the work, that the expenses for the supervision and inspection shall be included in computing the cost of the work, but the actual cost of making preliminary inspections and surveys and for the supervision and inspection of the construction and maintenance by the said director or his deputies shall be borne wholly by the State and paid from the funds appropriated for the purpose. It is also provided that any person obstructing the work of examining, surveying, or ditching or otherwise treating such mosquito-breeding areas, or obstructing any ditch, canal, or drain, or the natural outlet of any marsh-forming, mosquito-breeding area shall be fined not more than $100 or imprisoned not more than 90 days or both.

Florida.—The State road department has a regulation relative to drainage and borrow pits along highways. The standard railway sanitary code also has some antimosquito provisions. In addition, a general statute has provisions concerning the sinking of wells for drainage purposes, and there is a drainage law empowering districts to drain large areas of land.

Mississippi.—Regulations providing that it shall be unlawful to maintain or permit in any of the counties in which the antimalaria work is being done by the State board of health or cooperative agencies, any standing or flowing water in which mosquitoes breed or are likely to breed unless such collections of water are treated by an approved method so as to effectively prevent such breeding.

South Carolina.—Impounded water: Mosquito breeding in impounded waters can be declared a nuisance and dam ordered removed. (Note.—The questionnaire does not state whether this law has ever been enforced.)

Virginia.—No special laws, but there have been several decisions by the courts which have required railway companies to eliminate mosquito-breeding places along the rights of way when it was proved that the company was responsible for the creation of such breeding places, either by diverting the creek or by borrow pits.

In the opinion of the committee the most important legislation needed at the present time, especially in the Southern States, is with regard to State supervision or impounded waters and providing that the plans and specifications of such projects shall be approved by the State boards of health so far as mosquito breeding is concerned. Under present conditions, except in the few States which have been mentioned, no action, except in an advisory way can be taken until after the area is flooded and then only when it is proved that the public health is seriously affected.

A great many mosquito-breeding places are caused by improper drainage of depressions along highways and railroad rights of way. An effort should be made to persuade all State highway departments and railway companies in those States where mosquito control is being done, to adopt and enforce specifications regarding the proper placing of culverts and draining of borrow pits in order to prevent the creation of new mosquito-breeding places.

REPORTING MALARIA.

All except seven of the States require physicians to report cases of malaria, but it is practically admitted that such reports are far from complete and not indicative of the true prevalence of the disease. In the opinion of your committee it will be many years before the morbidity statistics will be trustworthy. Mortality statistics are of little value in estimating the number of cases in a given district.

As shown in Table I only one of the States estimates that the percentage of reported cases is above 50, three between 25 and 50 per cent and the others less than 10 per cent. This brings up the question as to what method is best suited to determine the amount of malaria in any State. Replies to this question were varied, some stating that it is impossible, with perhaps a slight balance in favor of the census method. Determination by spleen examination was not mentioned, nor does your committee feel that this method lends itself readily to widespread application. A complete malaria census carefully taken, is, in the opinion of your committee, the only practical method which will give results anywhere near the actual truth. In this connection it may be stated that a subcommittee of the National Malaria Committee is at present working for the betterment of malaria morbidity statistics.

TABLE II.

State.	Full-time personnel.		Funds.					
			State.			Other sources.		
	State.	Other sources.	1919	1920	1921	1919	1920	1921
Alabama	1	2		$5,000.00	$5,000.00		$15,000.00	$15,000.00
Arkansas		2			5,000.00	$29,650.00	33,752.00	
California	2		$15,000.00		10,000.00			
Connecticut	2		3,610.83	6,199.89	4,142.00			
Florida	2		(1)					
Georgia		4		6,124.41			74,783.57	
Kentucky	1		(2)					
Louisiana		2		500.00	5,000.00		14,825.27	
Mississippi	1	4		5,178.00	2,996.00		11,868.00	18,432.00
New Mexico	1				2,000.00			
North Carolina		1		?			24,018.42	
Rhode Island		(3)		20,000.00	20,000.00			
South Carolina	2	2		10,000.00	15,000.00		30,500.00	35,000.00
Tennessee	(4)		(5)					
Texas	1	3		6,000.00				
Virginia		2		1,500.00	5,000.00		6,250.00	
New Jersey	2		265,000.00	265,000.00	265,000.00			

[1] No information, general funds used.
[2] No data available.
[3] Local only.
[4] Work under supervision of United States Public Health Service.
[5] No funds given.

In Table II the personnel from "Other sources" in the majority of instances means the personnel furnished by the Federal Government and International Health Board, and funds from "Other sources" come either from local communities concerned or from the International Health Board.

As to the source of funds, eight States prefer State aid to local communities in addition to supervision. Five prefer total appropriation by local communities with supervision from State; three give this second place and one places it third. One prefers State aid for the first year, the community to assume control, under State supervision, thereafter. One State suggests entire State control of larger problems. Several of the replies are of particular interest and are quoted as follows:

Arkansas.—"Of necessity, all funds for the actual performance of work are provided by the community. It would seem more proper and equitable, however, to have joint appropriations from the Federal, State, and local governments supplemented by voluntary agencies when available."

Connecticut.—"It is believed that in any work of this kind there should be some provision for State aid, particularly for supervision and preliminary surveys, in order to see that it is carried out properly."

Georgia.—"It is believed that the State, where possible, should offer aid to localities to carry on malaria work in addition to supervision, as it is not only a local problem but a State problem; also that the United States Government should offer funds to different States to be distributed in local communities. It is very important to the United States Government in case of war to have its fighting forces fit for service."

Missouri.—"State aid in addition to supervision is thought to be indispensable to get the communities to do much, if any of the mosquito control work in this State, since the value of the work is so little appreciated generally."

South Carolina.—"State aid is given to localities in addition to the supervision, because (*a*) financial condition of towns prohibits work and (*b*) appeal is made on the basis that outside money will be spent if town puts up its share. We can not appeal to people on the grounds of economic loss, as money is too tight."

Tennessee.—"The division of engineering of the State board of health should make surveys and estimates of cost of malaria control operations and should appropriate a part of the money to get the work started and carried on for the first year as an inducement to the localities to institute control measures. After the area has been placed under control, the maintenance costs should be borne by the locality, the only contribution by the State being the services of the engineering division in supervision."

Texas.—"Assistance in financing malaria control operations does not lead to permanent control whether the funds be furnished by State, national, or other sources. All campaigns in Texas are financed solely by the communities during 1921."

TABLE III.—*Showing type of community in which control work has been done during last six years, and division of funds in 1920.*

State.	Municipalities.	Rural communities.	Whole counties.	Division of funds in 1920 (per cent).			
				Population.		Rural.	Special.
				Over 10,000.	1-10.		
Alabama	21			22.5	77.5		
Arkansas	16	9		36.0	64.0		
California	5	10		[1] 33.0		[1] 67.0	
Connecticut	8	4		14.0	43.0	4.0	39.
Georgia	5	1	2	73.0	9.0	18.0	
Kentucky	1		1				
Louisiana	3				83.0		6.
Mississippi	18	4	4		100.0		
New Mexico		*				100.0	
North Carolina	7			41.0	59.0		
Pennsylvania	3		1				
Rhode Island	9	2					
South Carolina	3				100.0		
Tennessee	2	2					
Texas	24		1				10
Virginia	10	5	2		100.0		

[1] 1919 funds.

Connecticut.—Used 39 per cent of its total appropriation in general supervision of all work.

Texas.—Texas reports as follows: "Funds in 1920 were spent in general education and publicity. Control measures by field engineers were carried out in 13 communities ranging in population from 400 to 7,000, and none in rural districts."

It appears that by far the larger portion of mosquito and malaria control work has been done on a community basis; in fact, 88 per cent of the $211,525 available in 10 of the States in 1920 was spent in community control, and 9 States prefer community control as a basis.

Alabama.—"We confine ourselves to community work, realizing that malaria control is entirely an economic problem. Better rural conditions will come naturally as the land is cleared and drained for cultivation."

Missouri.—"Education along these lines has been so woefully inadequate in the past that an intensive and extensive educational campaign must be carried on with community control to get the full value of the work."

Tennessee.—"Community control is the only feasible method in this State at present, and probably will be for a considerable time to come. Very few county health departments have been developed sufficiently to render them efficient in carrying on rural control as a routine practice. For the present, at least, the best results will be obtained by each community, with the cooperation of the State department of health."

Texas.—"No one method will insure malaria control. While at present practically all control measures are being conducted in urban communities, it is not expected that a continuation of this policy exclusively will obtain the best results. Rural control will consist, however, of drainage and fish control almost exclusively, due to the care and labor required in oiling operations. Rural activities will have to come from spreading of urban demonstrations and not independent operations."

Georgia.—"It is believed that community control is the most important because much more permanent work can be brought about under this head."

Several States in favor of policies other than community control are:

Connecticut.—"A bill was introduced into the present session of the general assembly revising (mosquito) law and placing the entire matter under the director, the expenses to be borne by the State. There are many reasons for this. To begin with, the present law provides for local initiative, with the result that certain towns have ditched all of their salt marsh areas while the adjoining towns would take no action. As the salt marsh mosquitoes migrate for considerable distances, the work already done is not as effective as it should be if all of these towns took similar action. I believe heartily in universal education along these lines, because no matter how well the larger problems will be solved, there will always be the problems of the rain-barrel mosquito on private premises. Then, too, the sooner the people become educated to the importance of such work the sooner can any State put through a scheme for cleaning up its own mosquito-breeding territories."

South Carolina.—"Education decidedly needed. Believe that an extensive educational campaign will give better results than a sporadic control work. Many laymen and some doctors are still skeptical as to the mosquito theory. If the $25,000 available now were spent on advertising, lectures, fair exhibits, etc., I believe an untold amount of good will be obtained. Campaigns would necessitate an experienced, able advertising manager. Work done by the United States Public Health Service, Red Cross, etc., about cantonments has been almost entirely abandoned in South Carolina. Where done or kept up at all it is within city limits and this is not satisfactory as to mosquito control."

In Virginia community control demonstrations have been made for several years past by State aid under the general supervision of the United States Public Health Service and it has been increasingly apparent that the plan is faulty in that the greater problem of rural malaria control has not been attacked. Communities do not always continue work in years following the first demonstration. New communities are loath to take up the work, partly from lack of funds and partly through lack of the realization of the need. At the same time it must be remembered that the control measures in the municipalities have very little effect on the incidence of malaria in the rural districts, nor are the same methods always applicable to both. The work already done in rural districts is entirely different. Past work has demonstrated that the control of malaria and mosquitoes in urban communities is a practical operation when the people and officials will appropriate the necessary funds. In our opinion the next line of attack is in the rural sections.

One county has been selected and a sanitary demonstrator who has been working in it for the past year has been detailed to give his entire time to malaria work during the present summer. He will carry on an intensive educational campaign and visit as many homes as possible to instruct the people as to what they should do for their own protection and also to secure complete records as to cases of malaria and how much time was lost and to make follow-up visits from time to time as may be necessary. In this particular instance, the demonstrator is personally acquainted with and trusted by the people. He thoroughly understands his people and their peculiarity, and tries to show them how to solve their individual mosquito and malaria problems. At the same time he is gathering information which will be of much value in reaching a satisfactory solution of the rural malaria problem. The people have shown such a remarkable interest and spirit of cooperation in this new line of work that the plan will be extended to include several other counties, with a sanitary demonstrator for each, and all under a medical man appointed by the State board to give his full time to malaria study and supervision.

ORGANIZATION.

The answers to a question as to the organization best suited to handle the mosquito and malaria problem show a large preference for the engineering division of the State board of health. Nine give this first choice, two give it second, and two give it third. Three States choose the county and rural health division.

Arkansas.—"Division of malaria control under the bureau of sanitary engineering, with doctor trained in malaria control work as director with a chief sanitary engineer in charge of all work exclusive of medical measures. Where there is a local health organization malaria control should be linked with its program."

Connecticut.—"In Connecticut the organization of antimosquito work has been placed in charge of the director of this agricultural experiment station, though the details of the work are in a large measure supervised by this department, particularly in an advisory capacity. As regards organization, it does not seem to me so very important whether such work is organized under the State board of health or some other agency well suited to carry it on, the members of which are familiar with such problems. In Connecticut the State board of health has acted in an advisory capacity many times, but it has never taken hold of the work in an active manner. Many local health officers have done excellent work in their towns, particularly on the smaller problems and where malarial mosquitoes are breeding. Most of the work in Connecticut has been done through community control, except during the past six years, when State aid has been available. If every community would take up the problem our present system would be adequate and effective."

Florida.—"All malaria control activities are under the engineering division, with a chief sanitary engineer having general supervision."

Georgia.—"I believe that malaria activities should come under the engineering division, as it is almost wholly a question of drainage, followed by other methods which involve a certain amount of engineering supervision. If the work is to be wholly quinine sterilization, it should then come under a separate division of the State board of health, with a doctor in charge. After the work has been conducted by the State board of health or other agencies, it can then be left to the local health officer or county health division to be carried on, the State board of health acting only in an advisory capacity."

Mississippi.—"It is my personal opinion that operations for the prevention and control of malaria should be directed as a part of the activities of the bureau of sanitary engineering, under the general supervision of the State sanitary engineer. By this means all work of sanitation requiring engineering services may be coordinated and given its relative importance. Where work of malaria control is being carried out as a part of the county health unit program, an engineer may be assigned to this particular county at the very inception of the work, with instructions to make a survey and report, including an estimate of cost of the work in the several communities, towns and cities, wherein the work would be feasible, and recommending a general plan of procedure. Copies of this report should be submitted to the State sanitary engineer and the director of the county unit. This report should state not only in what communities the work would be impractical, but with this data in hand the director would be in a position to state clearly to the board of supervisors and other interested parties just what the malaria phase of the work would consist of and could give a definite cost. In this connection the engineer should work under the direct supervision of the director of the health unit, subject, of course, to the call of the State sanitary engineer for preliminary surveys and reports at times when this special work would not conflict with the duties already begun in the unit."

Missouri.—"Malaria control being so largely an engineering question, and the doctors of this State being so generally uninterested in public-health work but more in the practice of medicine, it is thought that this work could be better handled by the engineering division when that is organized."

South Carolina.—"As part of an engineering section under chief engineer, because work, to be permanent, is essentially one of drainage and eradication of mosquitoes. In South Carolina malaria control is main activity for an engineering section and funds can be secured on this project, whereas water and sewage control can not."

Tennessee.—"The work of malaria or mosquito control, being a health problem of more than local interest, should unquestionably come under the jurisdiction of the State board of health, and as it is largely an engineering problem, its direct supervision should be a part of the duties of the division of engineering of that board. The cooperation of the local health organization should be sought, in order to reduce to the minimum the supervision of details by the State engineer."

Texas.—"Malaria control is unquestionably an engineer's problem in the heavily infested areas of this State, and the supervision of this work must be under the direction of one acquainted with an engineer's problems. The work should be preferably directed by an engineer with field experience in order that the situation might be fully appreciated and the most efficient results obtained."

METHODS.

Elimination of the mosquito by drainage operations is the method given preference in 12 States and in 1 place, oiling first.

Connecticut.—"Nearly all of the work in Connecticut has been done by ditching swampy areas and by filling depressions. Some oiling has been done, but this is only a temporary expedient. We have had some experience in building dikes and tide gates, these being incidental to the general problem, especially on salt marshes."

CONTROL METHODS.

No new methods were brought out in the replies to the questionnaire. Those used in the various States have for the most part been published by the Public Health Service or in the reports and bulletins issued by the various State boards.

CONCLUSIONS.

Your committee has attempted to present in this report merely a summary concerning the progress of mosquito control and opinions from different States with regard to organization, expenditure of funds, and legislation with the hope that the discussions may bring out facts which will be helpful to the members of the association. Malaria control is yet in its infancy and much remains to be done before conclusions can be reached as to the best policies and methods applicable to the country as a whole or any group of States in which conditions are similar. One fact, however, must not be lost sight of, the public does not yet appreciate that there are practical methods by which mosquitoes can be controlled with a reasonable expenditure of funds. Hence publicity and education should be carried on more vigorously than ever. We believe that Dr. T. H. D. Griffitts has the right point of view when he says:

> I feel that I have done my best day's work in malaria prevention after having talked to public-school teachers and students of the essentials of the cause and prevention of malaria. If the public thinks—and thinks rightly—they will act rightly, and results will make a bold showing 10 years from now.

A motion was made, seconded, and approved to adopt this report.

Mr. Gage presented the following report:

REPORT OF COMMITTEE ON SWIMMING POOLS.

For the past two years, a committee of the sanitary engineering section of the American Public Health Association has been engaged in a study of various phases relating to the sanitation of swimming pools and other bathing places. As the work of your committee must necessarily cover the same field as that of the American Public Health Association committee, it has seemed to us that useless duplication of effort could be avoided and more real progress made by coordinating work of these two committees, and this coordination has readily been accomplished through the fact that all members of your committee are also members of the American Public Health Association committee.

In this report, we wish to emphasize certain facts obtained by the American Public Health Association committee, to briefly review certain rules which have been promulgated for the regulation of swimming pools, and to submit for criticism and suggestion certain tentative rules, the observance of which we believe might prevent undue pollution of swimming-pool waters.

In 1920, the American Public Health Association committee requested the sanitary engineers of the various States to assist in the collection of statistics of swimming pools in territory under their jurisdiction. In response to this request, information regarding 506 pools was obtained from 18 States. Data relating to 42 pools in 7 other States was obtained from outside sources. The Public Health authorities of 30 of the 48 States were unable to supply the committee with information even as to the number and location of pools within their territory.

It seems strangely inconsistent that although the publicity organs of many State and city health departments have from time to time emphasized the hygienic importance of bathing, very few such departments have taken the pains to inform themselves as to the sanitary conditions, or, should we say, lack of sanitary conditions, which prevail at their various public bathing places.

It is generally recognized that certain diseases may be transmitted through contamination of swimming-pool water. To properly safeguard against the carriage of infection in this manner, swimming pools should either be emptied and refilled frequently or the entire body of water should be disinfected at regular and frequent intervals.

Refiltration without disinfection can not usually be relied upon to completely remove bacterial contamination.

A study of the statistics obtained by the American Public Health Association committee for 548 pools reveals the fact that in about one-third of these pools the water was allowed to remain three days or longer without any attempt at disinfection. At 7 pools, where no disinfectant was employed, the water was changed only once or twice a year and at 6 others the water remained in the pool two months or longer. In one instance, it was stated that the water was never changed or disinfected and that filters for clarifying the water had not been provided. Surely these are conditions well worthy of consideration by public health officials.

The various factors entering into the problem are so many and so varied and are so closely interrelated in their influence upon health and sanitation, that their full significance can only be appreciated and understood by a trained sanitary engineer.

For financial reasons, it is impossible for the usual Y. M. C. A., school or club to employ trained sanitarians to operate their swimming pools. Judging from the experience of the members of your committee, however, the managers of practically all such pools would be only too glad to cooperate with some central authority, such as the State health department, in order to improve the sanitary conditions at their various establishments.

In two States, California and Florida, sanitation of swimming pools is under the control of the State department of health by statutory provision. The State departments of health of West Virginia and Virginia have also passed regulations for the control of swimming pools under statutes authorizing them to formulate a sanitary code. The regulations adopted by these four States for the sanitary control of swimming pools are similar in character and embody the following features:

1. The bacterial contamination of the water in the pool must be maintained at a practicable minimum.
2. The water in the pool shall at all times of use be sufficiently transparent to enable a person standing at the side of the pool to distinctly see the bottom at a depth of 6 feet.
3. Facilities must be provided for adequately protecting the water against sputum contamination by bathers.
4. All persons known or suspected of being afflicted with any infectious diseases must be excluded from the pool.
5. Provision must be made to insure the personal cleanliness of bathers entering the pool.
6. Construction of the pool must be such as to reduce danger of injury from falls and collisions to a minimum.

7. Every reasonable precaution must be taken to prevent drowning accidents.

8. Dressing rooms, toilet rooms, shower baths, and other places to which patrons have access must be clean and well ventilated at all times.

9. Bathing suits and towels furnished by the pool management must be clean and free from bacterial contamination.

10. Rules which must be observed by patrons for the maintenance of a safe and sanitary pool must be posted in conspicuous places about the establishment.

Your committee feel that these are the minimum requirements for the maintenance of a safe and sanitary swimming pool.

In the California regulations the bacterial content of the water in a swimming pool has been tentatively limited to 1,000 bacteria per cubic centimeter determined on standard agar incubated 24 hours at body temperature, and the presence of fermenting bacteria to not more than one-half of the 1 cubic centimeter gas test.

In the Florida regulations a limit has been placed on the number of bathers who may be permitted to use a fill and draw pool.

In each of these States it is required that careful operation records and statistics of the use of the pool be kept by the management for the benefit of the State health officials.

It is well recognized that the amount of dirt and dangerous contamination introduced into any swimming pool is dependent upon the relation between the volume of water, the number of bathers, and the frequency with which the water is either changed or purified and disinfected. It has occurred to us, therefore, that the reasonable cleanliness and freedom from contamination of the water in any swimming pool might be assured by limiting the number of bathers permitted to use that pool in a given time.

Some years ago Gage proposed the term "bathing load" to express the relation between the volume of a pool and the number of bathers using it during any stated time. More recently Fair has proposed two other terms to indicate, respectively, the relative danger of transmission of disease and the probable dirtiness of the water in different pools. One of these terms, "the index of contamination," expresses the relation between the number of bathers, the volume of water in the pool, and the effective measures taken to remove or destroy bacterial contamination. The other term, "the index of stagnation," expresses the relation between the number of bathers, the volume of water, and the measures taken to remove dirt from the water.

For the purpose of determining the reasonable usage of a swimming pool, the committee has made a study of the bathing load, index of stagnation, and the index of contamination in their relation to the chemical and bacterial quality of the water in a number of pools where all factors which might influence pollution and contamination are accurately known.

As a result of these studies we offer for further study and criticism the following rules limiting the bathing load upon swimming pools:

1. The total number of bathers using a swimming pool during any period of time shall not exceed 20 persons for each thousand gallons of clean water added, to the pool during that period. The term clean water as used above may be interpreted to mean, new, clean water used to refill the pool, new, clean water used to replace loss by splashing or during cleaning, water taken from the pool and returned after effective filtration, or any combination of such waters.

2. The total number of bathers permitted to use a swimming pool during any period of time shall not exceed seven persons for each thousand gallons of water in the pool unless the pool shall have been completely disinfected at least once during that period by means approved by the State department of health.

In conclusion your committee would suggest that its work be continued another year and that the coordination of this work with that of the committee on bathing places of the sanitary engineering section of the American Public Health Association be approved.

A motion was made, seconded, and approved to adopt this report.

Mr. Theodore Horton submitted the following report:

CONSTITUTION OF THE CONFERENCE OF STATE SANITARY ENGINEERS.

Article I.

This conference shall be called the Conference of State Sanitary Engineers.

Article II.

The object of this conference is to coordinate the public health engineering activities of the official State health organizations and to encourage the interchange of experiences among sanitary engineers in official administrative positions.

Article III.

Membership shall consist of representatives from each State government and from the United States Government. The representatives of each State government may include the chief sanitary engineer of the State health department and other chief sanitary engineering officials having charge of sanitary engineering work of the States. The representatives of the United States Government may include sanitary engineers of the United States Public Health Service, not to exceed three in number, engaged upon sanitary engineering work. Eligibility shall be determined by the executive committee. Any member may delegate one of his assistants to represent him at any conference.

ARTICLE IV.

Each State shall be entitled to one vote, and the United States Public Health Service shall be entitled to one vote. A majority vote shall be necessary to decide all questions which come before the conference.

ARTICLE V.

The officers shall be a chairman, vice chairman, secretary-treasurer, and corresponding secretary.

All officers shall be selected by ballot biannually, except the corresponding secretary, which position shall be filled by the Public Health Service sanitary engineer detailed at the bureau in Washington. Officers so elected shall not take office until the expiration of the conference at which they are elected.

ARTICLE VI.

The chairman, vice chairman, secretary-treasurer, and two other members, who shall be elected at the regular meeting of the conference, shall form the executive committee to carry out the work of the conference between meetings. Other committees shall be appointed by the conference or by the executive committee, as is found desirable.

ARTICLE VII.

The secretary-treasurer shall also be secretary of the executive committee and shall perform such duties as may be found necessary.

The corresponding secretary shall collect, analyze, and report to all State sanitary engineering divisions, data on the prevailing and proposed activities in sanitary engineering of probable interest to them, and shall perform such other duties as the executive committee may require of him.

ARTICLE VIII.

The time and place of the next meeting may be fixed at any session of the conference, or may be made subject to the call of the executive committee, providing chief sanitary engineers of at least 10 States signify their intention of attending such meeting.

ARTICLE IX.

Amendments to the constitution shall be voted on at sessions of the conference, and, if approved, shall then be presented by letter to all members of the conference for vote, an affirmative vote of two-thirds of the members of the conference being required for adoption.

It was moved, seconded, and passed that the proceedings of the meeting be printed and distributed to all the members of the conference.

The conference elected the following officers: Mr. Emerson, Pennsylvania, chairman; Mr. Dittoe, Ohio, vice chairman; Mr. Horton, New York, secretary.

The executive committee chosen consisted of Mr. Emerson, chairman; Mr. Dittoe, Mr. Horton, Mr. Whittaker, and Mr. Simons. Mr. Mendelsohn was retained as corresponding secretary.

Mr. Emerson delivered an address outlining plans for the next conference meeting and the work in the meantime.

A discussion was held on the program for the next meeting of the conference, it being decided that a letter should be sent each State sanitary engineer six months before the meeting requesting suggestions regarding the program. A program consisting of a series of limited discussions on topics chosen by the members was found most satisfactory.

A discussion was held on practices of engineering firms engaged in sanitary engineering construction work, also on the regulation of mausoleums by State health departments.

The conference then adjourned.

ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
10 CENTS PER COPY
▽

TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 124

MAY, 1922

THE FUTURE OF PUBLIC HEALTH IN THE UNITED STATES

AND THE

EDUCATION OF SANITARIANS

LIBRARY OF THE HARVARD MEDICAL SCHOOL
A

REPORT OF A CONFERENCE
Under the Auspices of
THE UNITED STATES PUBLIC HEALTH SERVICE
WASHINGTON, D. C.
MARCH 14 and 15, 1922

WASHINGTON
GOVERNMENT PRINTING OFFICE
1922

TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 124
MAY, 1922

THE FUTURE OF PUBLIC HEALTH IN THE UNITED STATES AND THE EDUCATION OF SANITARIANS

REPORT OF A CONFERENCE

Under the Auspices of
THE UNITED STATES PUBLIC HEALTH SERVICE
WASHINGTON, D. C.
MARCH 14 and 15, 1922

WASHINGTON
GOVERNMENT PRINTING OFFICE
1922

TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 124
MAY, 1922

THE FUTURE OF PUBLIC HEALTH IN THE UNITED STATES
AND THE
EDUCATION OF SANITARIANS

REPORT OF A CONFERENCE
Under the Auspices of
THE UNITED STATES PUBLIC HEALTH SERVICE
WASHINGTON, D. C.
MARCH 14 and 15, 1922

WASHINGTON
GOVERNMENT PRINTING OFFICE
1922

* LIBRARY OF THE * HARVARD MEDICAL SCHOOL

A^c 32 B. 1881.3, no. 124

THE FUTURE OF PUBLIC HEALTH IN THE UNITED STATES AND THE EDUCATION OF SANITARIANS.

On March 14 and 15, 1922, a group of educators and leaders in public-health work from all sections of the country met in Washington under the auspices of the United States Public Health Service to consider what is perhaps the most pressing problem in the field of public health to-day. This is not the discovery of new scientific facts, nor is it even the awakening of the public to the importance of public-health work. Rather, it is the problem of personnel. Within the last 50 years such an unparalleled development of scientific medicine and of the sciences which contribute to the public health has occurred that for a time additional discoveries have become of secondary importance. Furthermore, people to-day, as never before, realize the importance of public-health measures; they are demanding protection from the vast economic losses and incalculable suffering caused by preventable diseases. But an adequate number of trained workers are not available. Not only are the quantity and quality of those who are entering this field unequal to the needs, but adequate facilities for training do not exist. The practical application of the scientific knowledge which has become available and the effective utilization of the interest in public-health matters which has recently developed waits upon the improvement of this situation.

The purpose of the United States Public Health Service in arranging the "Conference on the Future of Public Health in the United States and the Education of Sanitarians"[1] is, therefore, apparent. By bringing together the leaders of the public-health movement and the university presidents and others now participating in the education of youth, it was thought that the seriousness of the personnel problem in public-health work might be more generally realized and some definite steps taken for the improvement of conditions. The conference was to concern itself frankly not only with the immediate problem of increasing the effectiveness of existing public-health activities, but also with the provision of a continuing supply of well-trained and ever more capable workers for the future. It was to prophesy lines of development, "to estimate future needs," as Doctor Barker declared in his paper on "Public Health and the Future Commonwealth," "and to visualize methods of meeting those needs." In all lines of endeavor it is necessary that once in so often a definite attempt be made to chart the seas as yet untraversed and to map out a course for the future. This the conference sought to accomplish.

---

[1] In organizing the conference, it early became evident that a term more adequate and accurately descriptive than "health officer" would be necessary. The term "health officer" is usually understood to include only those employed by a city, county, or State to protect the health of a population group and to enforce certain health laws. The conference was concerned not only with such persons, but also with those employed in many other capacities in the work of public health in the United States. The most suitable inclusive term available seemed to be "sanitarian." It is used throughout this report to include all persons who are employed professionally in public-health work.

The conference assembled at the American Red Cross Building, Washington, D. C., Tuesday, March 14. A list of 136 men and women who attended is included in an appendix. Purposely membership was limited to a selected group. It was felt that the best results could be secured by exchange of views of a comparatively small number of leaders. The distribution of the information presented and the wide application of the practical conclusions reached is the responsibility of those who did attend and of the Public Health Service.

The conference itself showed that it was needed. Upon the cooperation between educators and public-health workers depends in large measure the future progress of the public-health movement in the United States. Yet there was a very evident restraint between these two groups. They found difficulty in reaching a common ground. The conference by bringing them together and by emphasizing the necessity for mutual help performed a definite service.

It is only too evident that in the public health field itself a lack of understanding between different groups exists. Progress has been so remarkable, the invasion of new subjects has taken place so rapidly, that those in different specialties hardly realize what the others are doing. Their fundamental problem, the improvement of the public health, remains the same, but they are not altogether aware of their common interest. Full cooperation is impossible because of the lack of acquaintance one with the other. The different groups speak different languages and until there is created a definite consciousness of a common profession, the full possibilities of effective work will not be achieved.

THE CONFERENCE.

Surgeon General Cumming: Introductory address.

"This is," stated Surgeon General Cumming in opening the conference, "the first time at which exactly this sort of gathering has been called. It is an attempt to bring together around a conference table the presidents of universities and deans of medical schools and the men who are engaged in practical field work in public health. The situation in the United States at the present time with reference to the supply of public-health officers—local, State, and national—is acute. As a result of the war and the knowledge which was brought out at that time, there has been a great awakening of interest in public health throughout the country. This necessitates the training of more public-health workers to direct the energies and the potential forces which are available."

Surgeon General Cumming mentioned three difficulties which he felt should receive consideration. The first is the difficulty found by men already in the field in securing further technical training. Another difficulty is the uncertain tenure of office in public-health work. Unfortunately, it would seem as though this particular difficulty is becoming more serious. The third difficulty is the inadequate remuneration which is received by public-health officers. As will be seen, these matters received considerable attention from the conference.

Dr. William H. Welch, Johns Hopkins University: Chairman.

Introduced as chairman of the first session by the Surgeon General, Dr. William H. Welch, director of the school of hygiene and public health, Johns Hopkins University, expressed his appreciation to the Public Health Service for arranging the meeting. He declared that those who are engaged in trying to develop better opportunities for the training of public-health officers and others entering the field of sanitation and public health welcomed very much such a meeting. "It is of first importance," he said, "that we who are endeavoring to train men for public-health work should give very close attention to those who are actually at work in the field; it is important that there should be just such an exchange of views as can be anticipated at this conference."

I. THE PRESENT STATUS OF THE EDUCATION OF SANITARIANS.

(Dr. William H. Welch, presiding.)

Dr. Allen W. Freeman, Johns Hopkins University: Review of events leading to the present situation.

In order that those present might more intelligently consider the principal problems before the conference, the first three speakers discussed various phases of the present status of the education of sanitarians. In his review of events leading to the present situation, Dr. Allen W. Freeman, of Johns Hopkins University, showed that the rapid development of medical science during the last decades of the nineteenth century put upon the then existing public-health machinery an almost unbearable burden. The board of health as originally established was intended primarily to help in emergencies. Later its chief function was that of a sanitary police. With the further development of medical knowledge its inadequacy became more apparent. The board "had in its favor the fact that it was under the control of physicians and that the word 'health' occurred in the title." But little else!

"To meet the new needs and to supply the new service," said Doctor Freeman, "our official health agencies have undergone complete metamorphosis. Quarantine, fumigation, and sanitary inspection, once their only function, have become minor activities. The laboratory, the clinic, the epidemiologist, the nurse, and the social-worker carry on the real work of the health department to-day.

"The health officer is no longer a practicing physician, dropping in for half an hour in the morning to look over the mail and see that the clerk is running things properly. He is a whole-time executive, spending tens or hundreds of thousands of dollars a year and having under his control scores, hundreds, or thousands of employees. His task is exceedingly difficult. The science he has to apply is very extensive, highly specialized and constantly expanding. The government of which he is a part and through which he must work is cumbersome, beset by partisan politics and hampered by red tape. The people he serves are in a large part ignorant of the purpose and method of health work, are suspicious, sensitive, and inclined to resent interference with established habits and customs."

Doctor Freeman estimated that there are engaged in public-health work in the United States on a whole-time basis somewhat over 10,000 technical and semitechnical workers. This does not include the large number employed by voluntary agencies and by industrial concerns. Altogether it is probable that there are at least 16,000 persons occupying whole-time technical or semitechnical positions in health service. Each year approximately $35,000,000 is spent by States, cities, and counties for public-health work, and of this amount roughly 75 per cent is expended for personal services.

The effective use of the funds available and the efficient direction of the activities of these workers would seem to require not only a high degree of innate ability, but also considerable scientific training. Prior to entering the work, unfortunately, very few of those at present in charge of our health departments had had any training in preventive medicine, other than that possessed by the ordinary physician. Among the 342 principal and subordinate executive officers in State health departments, 58 per cent are physicians with medical training; only 1.05 per cent have received public-health training. Of the principal executives for 48 States and for 72 cities of 100,000 or over, 101 are physicians without public-health training and 6 are laymen with no professional training at all. At the present time, therefore, most public health work is in the hands of men without special education. That despite this fact considerable results have been accomplished is high tribute to the natural abilities—the intelligence, devotion, and energy—of those at work in the field.

An explanation for this discouraging situation is apparent when one considers the history and present status of "education for a

Dr. Milton J. Rosenau, Harvard Medical School: The present status of education for a public-health career.

public-health career," as Doctor Rosenau prefers to call it. This education, he declared, is still "in a formative and experimental stage." There is only one separately endowed school, the school of hygiene and public health at Johns Hopkins, and one school in process of formation at Harvard. The University of Pennsylvania announced a course leading to a degree for certificate in public health in 1906, but the first awards were not made until 1912. Harvard graduated its first doctor of public health in 1911. Special education for public-health careers is, therefore, a recent development. Practically all progress has come during the last decade, and before this the only school functioning was the school of experience.

In the year 1920, 72 public-health degrees of one sort or another were conferred at nine institutions. The number of degrees from the same number of schools increased to 106 in 1921. Much diversity exists in the practice of different institutions, and in many complete reorganization is in process. Considerable progress in standardizing entrance requirements, curricula, and degrees was made at a conference held at Yale University in 1919. There is still a complete lack of standardization, however.[1] At least 19 different degrees, for each of which the requirements vary from institution to institution, are given.

It was Doctor Rosenau's opinion that the fundamental requirements for admission should include a knowledge of the achievements and methods of various sciences—physics, chemistry, and biology—together with such training in medical subjects as is usually given during the first two years of a medical school course. Four degrees should suffice: Bachelor of public health, one year in residence in addition to the requirements named above; master of public health, one year graduate study; doctor of philosophy in hygiene, at least three years graduate study; and doctor of public health, a medical degree plus two years' graduate work.[2]

There has been a slow but steady and wholesome growth in the number of students attending courses in public health. Nevertheless, more are needed. "Those familiar with the present state of affairs," said Doctor Rosenau, "are quite well aware that the demand for well-trained health officials exceeds the supply." Furthermore, "public-health careers and the education for public-health service are not yet sufficiently developed to attract the best men in the field.

---

[1] Several speakers emphasized the danger of overstandardization. See p. 27.

[2] "I deprecate the multiplication of degrees," said Dr. M. P. Ravenel in the discussion at the conclusion of the session. "For practical purposes, the two outstanding ones are sufficient—certificate or master of public health and doctor of public health. What we need is a degree which will certify to the average public a man's qualifications for the position of health officer, and will guarantee to them that he has pursued courses of study which will fit him to be the guardian of health in a certain community."

The present status in this respect is unsatisfactory." The conference devoted considerable attention, as will be seen, to this problem.

Most education for public-health careers has developed in close relation with institutions for medical education. This is entirely natural and would seem from many points of view advantageous. The public-health school can obviously make use of much that the medical school has to offer and is in a strategic position to attract students. On the other hand, the medical school will gain through an increased emphasis placed upon prevention. Even to-day—and this was an opinion expressed by many at the conference—medical schools are devoting far too little attention to the preventive aspects of medical practice.

"A school of public health," said Doctor Rosenau, "however closely associated with a medical school, only accentuates the need of adequate teaching in hygiene in the medical curriculum. Every student working for a medical degree should get not only the facts, but also the viewpoint of prevention. In no other way can he do his full duty to both the patient and the public. The close association should inspire both the medical faculty and the medical student with the ideals of prevention and serve furthermore to reveal the opportunities and soul satisfaction derived in the service of Hygeia."

Dr. Frederick R. Green, American Medical Association: The 1922 Congress on Medical Education.

That the education of public health workers is not at the present time receiving adequate attention was strikingly indicated by the fact that at the 1922 Congress on Medical Education, Medical Licensure, Public Health and Hospitals of the American Medical Association, only one paper touching upon this problem was presented. "The five-day conference," said Doctor Green, "was filled with every subject that could be imagined in the field of medical education. But as far as I know the question of the education of health officers was not considered."[4]

Such is the situation at the present time with regard to the training of sanitarians. The need is critical, the existing facilities inadequate. Educators must cooperate with public-health workers in the improvement of conditions. A survey of the past and present only emphasizes the practical importance for the future of public health in the United States of the solution of the problem with which the conference was primarily concerned.

---

[4] In his paper at the Congress on the "Introduction of Public Health Information into the Undergraduate Medical Curriculum," Dr. Hans Zinsser of New York briefly referred to the development of facilities for the education of sanitarians. He was primarily concerned, however, with increasing the emphasis on the prevention of disease and the maintenance of public health in all medical education.

II. NEWER ASPECTS OF PUBLIC HEALTH AND THEIR IMPORTANCE IN TRAINING OF SANITARIANS.

(Dr. William H. Welch, presiding.)

As has already been suggested, the training of men for careers in public health becomes of particular importance in view of the wide expansion of this field which has occurred during recent years. Many new aspects of public health are now recognized which were unknown or neglected hardly a decade ago, and which are to-day little understood even by many of those who are engaged in public-health work. These aspects must be carefully considered in framing any program for the training of sanitarians. While those considered by the conference may not be the most important, they are among those which at the present time are most neglected by the medical schools and schools of public health.

Dr. William A. White, St. Elizabeths Hospital: Mental hygiene.

Mental hygiene is essentially a public-health problem, and no course in public health can properly omit the mental-hygiene aspects. A great deal is said about the necessity of a healthy body. But, however healthy a body may be, it will not be able to function properly without a healthy mind. To use Doctor White's words, "The body is only an instrument to bring to pass the ideas, the ideals, the aims and objects which our minds formulate, and unless our minds can formulate reasonable aims and objects, our healthy bodies are not of much use."

Mental hygiene, believes Doctor White, is now functioning in a variety of ways which justify its inclusion in a course of instruction in public health. Through out-patient departments in connection with psychiatric hospitals it is helping to prevent serious mental diseases. It is of great importance in connection with the problem of drug addiction, said to be largely on the increase in this country. The problems of the unusual child, of industrial fatigue, of feeble-mindedness are of significance in the general mental and social health of the community. To their solution mental hygiene can make large contributions. The public-health course of the future must, therefore, include some instruction concerning mental hygiene. Doctor White did not suggest the nature and scope of this instruction.

Dr. Richard M. Smith, Harvard University Medical School: Child hygiene.

The subject of child hygiene can not be properly considered apart from the general subject of public health. Doctor Smith did not feel it necessary to argue the importance of this work. Obviously it is a field in which effort will bring unusually large returns and upon which consequently considerable emphasis should be placed in the preparation of public-health workers.

It is of primary importance that the undergraduate student in the medical school should receive such training as will enable him to answer questions concerning the normal child. "At the present time," said Doctor Smith, "instruction in pediatrics in most medical schools is concerned with diagnosis of children ill with disease, and relatively little time is given to the consideration of the well child." The medical-school graduate should be friendly to the development of the public child hygiene movement. He should feel that this is a definite part of public-health work in which he can participate. Also he should know something of the activities in this field and of the organizations which are at work.

The man who is to specialize in child hygiene requires further training. He must understand the problem of infant feeding, inadequate nutrition. He must know the standards of normal development, the importance of posture. He must be well acquainted with the public and private activities in this field. School hygiene and health education are subjects in which he will have a particular interest. To summarize in Doctor Smith's words: "The man who is going into child hygiene work, or who is to be instructed in it, must have a very fundamental knowledge of medical sciences with reference to children, and must know how to apply that knowledge to the community."

Dr. Lee K. Frankel, Metropolitan Life Insurance Co.: Health examination.

A new public-health activity, particularly important from the point of view of financial return, was emphasized by Doctor Frankel. This is the periodic health examination. Some years ago, Prof. Irving Fisher figured that over $1,000,000,000 might be saved by the reduction of certain preventable diseases. His assumptions have been justified by events. In the future, said Doctor Frankel, the great savings will be made by the reduction of the degenerative diseases of middle age. A number of these diseases, to use his words, "are due to conditions existing in industry, to the rapid rate at which life must be led in large cities, to the marked changes which have taken place generally in our industrial development. We are just beginning to learn the effects of overwork and fatigue due to the length of the working day and the intensity of labor. With an increase in unemployment, there is a corresponding increase in the sickness rate. There are still other factors such as lack of recreation facilities, lack of laws enforcing ventilation."

These degenerative diseases will be checked by the general adoption of the periodic physical examination. This examination will lead to the discovery of the disease at an early stage when it is still amenable to treatment. Already this procedure has proved its value. Doctor Frankel gave this instance: "A recent examination of 100 postal employees, all of whom were at work at the time of the examination, showed that 12 of them were suffering from serious physical impairments which were disabling until treated and which required immediate medical or surgical attention; 53 showed advanced physical defects or impairments requiring systematic medical or surgical supervision and treatment; 33 showed moderate physical defects or impairments requiring medical supervision and treatment as well as hygienic correction, although the impairments were not necessarily disabling, and 5 showed moderate defects or impairments, requiring hygienic correction or minor medical, surgical, or dental treatment, which were not necessarily disabling. Not one of the 100 examined was free from some slight physical defect or impairment." The examination of a similar group of employees of the Metropolitan Life Insurance Co. led to the correction of 53 per cent of all impairments in one year. Examinations may be arranged by the community, by the employer, or by the individual. All have a definite interest in this preventive measure. But whoever assumes responsibility, the well educated and thoroughly trained health officer is essential for its successful application.

Economic and sociological aspects.

A number of other speakers during the conference dwelt upon the economic and sociological aspects of public health work. Dr. Lewellys F. Barker, for instance, said: "The growing conviction that the maintenance of physical and mental health of individuals is definitely related to the industrial, the social, and the economic conditions in which they find themselves would make it seem likely that in the near future the public health service will be compelled to play a rôle in the invention and application of contrivances that will insure for every person in the commonwealth standards of living that are not incompatible with the preservation of health or the maintenance of an abounding vitality." We know that the incidence of tuberculosis is definitely related to wage scales. We know that unemployment reacts upon health. We know that in determining a minimum wage, there must be due regard for the requirements of health. We know that in the interests of health, certain conditions of housing are demanded. While it is not incumbent upon the public health worker to solve these social problems, he should recognize their importance and be able to make his contribution to the betterment of conditions.

In his paper Dr. Frederick R. Green suggested a number of courses which should provide physicians and public health workers with the essential economic and sociological training. "It is my view," he said, "that the freshman class should be given at least one hour a week throughout the course on the history of medicine, so that the student will know something about the growth of his profession. During the second year, at least one hour a week should be given to medical sociology and the application of medicine and our knowledge of prevention of disease to social problems and social conditions. During the third year, one hour a week should be given to the economics of medicine. We are sending out to-day the most capable and highly trained medical graduates, so far as scientific training is concerned, we have ever been turning out. But we are not teaching them enough of the practical aspect of the profession. During the fourth year, one hour a week should be given to instruction, first, in the legal side of medicine—the legal relations of the physicians to society, to his individual patient, to his own professional associates—and then additional instruction should be given in the ethical side of medicine. Also instruction should be given regarding medical organization—the necessity for it, the history of medical organization, and the policies of our organization throughout the country."

Dr. Jesse F. Williams, Columbia University: Physical education.

If any great progress is to be made in public health there must be a definite program of physical education. This program must apply not only to those in the schools, but also to adults. It must help to equip young people with vigorous bodies and to maintain mature persons in a high state of physical efficiency. One way of avoiding disease is by maintaining a high degree of physical fitness. Doctor Williams felt that physical education is not a supplementary measure to be employed as a corrective of unhealthy conditions, but a fundamental scheme of physical activities for all. The physical educator, therefore, has an important place in the new public-health movement. To quote Doctor Williams: "Schools of public health could help tremendously in this problem of child health and child development by providing a training that would prepare men to head up departments (of physical education) in our city school systems."

Dr. Otto P. Geier, Cincinnati Milling Machine Co.: Industrial hygiene.

The public-health work carried on at the present time is not limited to public-health officers. Many employers are recognizing that upon the health of their workers depends in large measure the efficiency of their plants. They are, therefore, providing comprehensive medical service which not only deals with the incidental accidents and sicknesses; but also, by periodic health examination, by the improvement of working conditions, by the observation of conditions in the homes of the workers, aims to maintain high standards of physical efficiency. Over 4,000,000 workers are now enjoying this supervision. This work becomes of special importance because of the prevalence of certain industrial diseases. It is clearly recognized that tuberculosis is frequently the result of working conditions. Industrial fatigue is essentially a problem in public health because through fatigue susceptibility to disease is markedly increased. The school for the education of workers in the public-health field must, therefore, provide courses for industrial physicians and so aid both in the increase in the number of plants at which medical service is provided and in the expansion of the service rendered to the employees. "All phases of industrial medicine," said Dr. Geier, "should be brought into the school of public health, so as to give the student a slant on workaday life—to see preventive medicine, physical examinations, and curative medicine closely combined."

Probably no aspect of public health has received less attention in schools of public health than public-health education, or as some prefer to call it, popular instruction in health matters. Yet it is apparent that great accomplishments await the development and systematizing of this work. What has been done in the past, valuable as it is, has been accomplished largely by hit-or-miss methods. If public-health education is to assume the place in the public-health movement of the future which its practical value justifies, considerably more attention must be given to the training of men for this particular work.

Dr. Carl E. Seashore, University of Iowa: Public-health education.

"The first fundamental need in the organization of health education," said Doctor Seashore, "is a job analysis—a critical and constructive inventory of the situation showing in profile the various aspects of man toward which health education should be directed and the means at our disposal." Such a survey would throw into relief, first, a classification of the health acts and situations to be reached; second, an inventory of the motives, means, and avenues of personal appeal; and, third, the environmental approaches. On the basis of this study, the principles which have been or are being formulated by the educational and advertising psychologists may be practically applied. Unfortunately up to the present time little psychological study has been made of the materials used for public-health education. We are perhaps realizing that more can be accomplished by short, simply worded pamphlets than by those containing a long and reasoned argument. We are recognizing the value of visual methods.

It is clear, however, that psychologists themselves must learn more about the practical application of their principles, and that they must undertake further research in the suitability of the material available. Such research must be a continuous process. Whenever new educational material is prepared it must be carefully criticized in the light of the best psychology. And although the general worker in the field of public health can not be expected to be an expert in educational psychology, while he can not himself always apply the principles of that science, he should at least recognize the necessity for the employment of the trained psychologist. A given piece of propaganda may easily result in harm rather than good, if in carrying it out the best principles of educational psychology are not applied.[5]

The discussion at the conclusion of this session was led by Dr. M. P. Ravenel,[6] University of Missouri; Dr. Willard S. Small, United States Bureau of Education; and Dr. D. B. Armstrong, National Health Council.

Discussion: Dr. W. S. Small, Dr. D. B. Armstrong, and others.

Doctor Small limited his remarks to a discussion of the subject of health education. "I have little faith," he said, "that propaganda is going to get you very far. * * * In my opinion, the really important things in education are brought about by long, intensive, and carefully planned efforts." Special attention, he declared, should be given to the education of the so-called educated part of the public. Reach the institutions of higher learning and you will reach the masses.

Doctor Small was flatly contradicted by Dr. Hermann M. Biggs, commissioner of health, State of New York. "We have accomplished almost everything by propaganda," said Doctor Biggs. The remarkable achievements of the last 30 years have been the result of the education of the masses. The leading men in the community are the last ones to try to educate. "Last of all," he said, "comes the medical profession."

Doctor Armstrong called attention to the large number of public-health workers which would be needed in the future. He declared that we must look to psychology to tell us how to find a motive force that will make our knowledge of hygiene effective to the individual and to the community.

It will be seen from this brief consideration of the newer aspects of public health that the public-health field now includes a large number of specialties which were unknown only a few years ago. Some of these specialties are destined to assume even greater importance as they are more carefully studied. No doubt, the field of public health will expand considerably in the future. A decade ago few individuals recognized the importance of physical education or industrial hygiene. A decade hence new matters with which we are even now unfamiliar may assume superlative importance. If the education of sanitarians is to provide for this future expansion, it will at least recognize the many aspects of the field which are already worthy of consideration and which by broadening the attitude of the student increase his adaptability to future developments.

---

[5] Doctor Winslow believes that the expert in public-health education has a very important place in the health work of the future. See p. 14.

[6] Doctor Ravenel's remarks: see p. 5.

III. WHAT KIND OF SANITARIANS ARE NEEDED FOR THE FUTURE?

(Dr. Hubert Work, presiding.)

Dr. C.-E. A. Winslow, Yale University: Into what specialized fields will public-health work be differentiated?

The rapid expansion of the public-health field which has been suggested and the development of a large number of specialties will necessitate many different groups of public-health workers in the future. Public health is not an individualized branch of science, like chemistry or mathematics; it is a field of social activity in which a variety of workers have a common aim. Doctor Winslow would classify these workers into four groups.

The first group consists of those who are primarily concerned with the human body and its functions. It includes (1) the physician, "who is," to use Doctor Winslow's words, "and is likely to continue to be, the leading figure in the public-health campaign; (2) the nurse, who is par excellence the teacher who carries the gospel of health into the individual home; (3) the nutrition expert, who is becoming an essential factor in the work of health centers, visiting nurses associations, and the like, and will almost certainly in the future be frequently employed by official health organizations of city and state; (4) the expert in physical training, usually employed in the department of education but logically and properly a member of the army of public health; (5) the dentist, who is already recognized as an essential factor in the machinery for safeguarding the health of the community; (6) the psychologist, who must assist in the maintenance of mental hygiene." All these specialists contribute to the public health through maintaining the human body in a state of health, able to perform its natural functions.

The second group of specialists are those who are primarily concerned with the nonliving environment of man. Here are found (7) the chemist, who applies his knowledge to the problems of water supply, sewage disposal, food control, and the testing of disinfectants; (8) the sanitary engineer, including not only the engineer who has specialized in water supply and sewage disposal, but also the heating and ventilating engineer and the specialist in building construction; (9) the inspector, "one of the most important and most neglected figures in the whole public-health field." As yet no provision whatsoever has been made in the United States for the training of the inspector.

The third group of specialists in public health are those who are primarily concerned with the parasitic enemies of man. In this group will be included (10) the bacteriologist, and protozoologist, and (11) the entomologist. These specialists pry into the secrets of the microscopic world. Upon them depends the maintenance of a pure water and milk supply. Through them developments in the field of immunology are to be attained. The entomologist will deal with the control of insect carriers of disease, and will be particularly useful in the Tropics where insect life abounds.

The fourth group are primarily interested in the social environment of man. As has been said, we are beginning to recognize the economic and social factors which play such an important part in the causation of disease. These questions are chiefly the concern of (12) the sociologist and the social worker. Included in this field also are (13) the statistician, who furnishes essential information for the prosecution of a public-health campaign, (14) the lawyer, who specializes in sanitary law, and finally (15) the expert in public-health education. "As the public-health campaign has become more and more consciously a campaign of education," said Doctor Winslow, "the larger State and city departments have begun to employ specialists in the technique of publicity. This field is certain to grow and expand in the near future. The technique of lecture service and the organization of exhibits, of motion pictures, of newspaper and other publicity is a technique which can only be fully mastered by one who devotes himself preeminently to this special type of service."

In this classification, no place has been made for the public-health administrator and for the teacher in the school of public-health. Doctor Winslow feels that these individuals will receive a basic training in one or another of the specialties and gradually assimilate through experience or post-graduate education the various factors in the general problem with which they must be acquainted. There is need for a special type of training for administrative work in the public-health field. This may either be superimposed upon a medical education or develop as an alternative to the usual last two years of work for the medical degree.

"The school of public health," said Doctor Winslow, "is less a parent stem from which its various specialties branch off than a finishing place at which men trained in diverse fundamental disciplines may come to gain a broader knowledge of the place in this field of their own specialty." For some types of workers specified above, such training is not essential. For the others, however, at least one year of educational work in the broader problems of sanitation is necessary. "It is for the purpose of converting the physician, the nurse, the bacteriologist, the social worker, the statistician into a public-health physician, a public-health nurse, a public-health bacteriologist, a public-health social worker and a public-health statistician that the certificate in public health has been created." This course will give a broad view of the entire field and permit additional specialization along the line which the student may desire to pursue.

In addition to the certificate in public health, provision must be made for the degree of doctor of philosophy in public health and the degree of doctor of public health. The former is to be open to the advanced worker and teacher in specialized fields; the latter to the administrator who has received at least two years of post-graduate training following the medical degree. These degrees provide the essential educational machinery necessary for the preparation of all groups of sanitarians except perhaps the sanitary inspector. Thus far training for this group has found no place at all in our educational scheme. As in England, it can perhaps best be organized outside the walls of the university, in special institutions created for the purpose.

Dr. W. H. Brown, National Child Health Council: What kind of men will be needed in the local health unit?

A large proportion of the public-health work of the future will be done by local health units. This is the agency through which public health is brought to the "ultimate consumer." At the present time the character and efficiency of the local health unit is not such as to encourage public support and confidence. "I believe it will be necessary for us," said Doctor Brown, "to improve constantly the character and efficiency of the work of our local health units."

"The most important single factor required to secure adequate health service for local communities is," he continued, "a competent sanitarian. This particular health worker occupies a most important place in our present plan of health administration. He is the selling and distributing agent. Through him must be delivered to the ultimate consumer the accumulated results of research and experience. Consequently, the success of our efforts to improve the public health will be largely conditioned upon the character, training, and experience of this group of individuals. The type of sanitarian needed for this task is the general practitioner of public health."

The general practitioner of public health needs a certain amount of technical training. "He should be well grounded in the basic medical sciences and possess a knowledge of the elements of medicine, surgery, and pediatrics. To this must be added a sound training in hygiene, sanitation, preventive medicine, vital statistics and public-health administration. In addition he needs a speaking acquaintance with all of the specialties of public health. This is his technical equipment."

Of equal importance is training in what Doctor Brown called "social engineering." This is not being provided at the present time. The worker in charge of the local health unit must be able to use all the available resources, both official and nonofficial. Voluntary agencies are of tremendous value, not only in securing support for the work of the sanitarian, but also in helping to translate into permanent government machinery the newer ideas for the preservation of health.

To quote Doctor Brown again: "The successful leader in public health must by his presence and personality be able to influence people. Armed with a knowledge of social and political organization, he must be capable of meeting Government officials and the general public. This necessitates the ability to speak effectively and to exercise public-health diplomacy. Few trained sanitarians fail on account of a lack of technical knowledge; many fail for the lack of the qualities of leadership. It is true that some of these skills and qualities are difficult to impart, but our schools for training sanitarians should make a serious attempt to solve the problem."

One type of essential training remains to be mentioned—practical work in the field. This subject will receive further consideration later. It is a point to which considerable attention was devoted throughout the conference and about which there was at the Wednesday afternoon round table considerable discussion.[7]

Dr. A. J. McLaughlin, United States Public Health Service: What kind of men will be needed in larger administrative tasks?

In the larger administrative tasks of public health as in the work of the local unit, the man needed is the general practitioner of public health. No man, no matter how skilled in a particular specialty, can aspire to the higher administrative positions unless he has had a general training. Not only must he have a basic medical training, but also he must add to it a general knowledge of every phase of health work—epidemiology, vital statistics, bacteriology, sanitary engineering, child, mental, and industrial hygiene, public-health administration, including business methods, and public-health education. Without this general background he can not expect to escape from his own specialty. A highly specialized public-health training has serious limitations concerning which students in the field should be frankly informed.

"The public-health administrator of the future must be less of a policeman and more of a statesman than the health officer of the past," said Dr. McLaughlin. The police power is a necessary foundation, but it is clear that a significant reduction in morbidity or mortality will depend upon voluntary cooperation rather than upon compulsion. The public-health administrator must be a business man. He must understand business methods, cost accounting, and budgetary systems. "* * * He must have the vision to plan and take up promptly new lines of attack on public-health problems.

---

[7] See pp. 31-32.

* * * He must have the wisdom and the courage to relegate to other departments of Government indirect health activities which do not properly belong in the health department, retaining through cooperation a consultant relation to such work. He must possess the qualifications of a statesman because he will find it necessary to control and utilize all sorts of unofficial, voluntary health agencies and spontaneous popular movements. The ideal health administrator will attempt to make every citizen of the State feel that he is a partner in the enterprise of public health and an integral part of the public-health machine."

How is a man to acquire the qualifications necessary for a public-health administrator? Two ways are possible: Experience alone, or training in a school of public health plus experience. The second method is, of course, superior. Even in the matter of personality, training will be of value. In Doctor McLaughlin's words, "Many of the qualities which are grouped under the rather indefinite label, personality, can be taught. Many faults of character can be curbed, controlled, or eliminated, and good qualities developed by taking advantage of the imitative faculty of the young and furnishing in our teaching the proper models for imitation." Special public-health schools will be necessary for this work.

In summarizing, Doctor McLaughlin said: "The successful health administrator of the future, in addition to his professional training, must be a business man and a statesman, and proficiency in these two phases can be acquired by proper courses of training in our schools. The qualities of a business man will inspire confidence in the legislative body which makes the appropriations, and the statesmanlike qualities will enable him to utilize to the best advantage all the official, unofficial, and voluntary agencies engaged in public-health activity."

Notwithstanding the remarkable progress in scientific medicine and other sciences connected with public health, the need for research work in this field continues. More and more information is needed if disease is to be eradicated. At the present time we are still ignorant concerning some of the most prevalent diseases.

Dr. A. M. Stimson, Hygienic Laboratory: What kind of men will be needed for research?

A special type of person is needed for research work. In Doctor Stimson's opinion, the following qualities are of importance: "(1) A passion for that sort of knowledge which can be experimentally verified; (2) an imagination which is sufficient to frame fruitful hypotheses—not bizarre, crazy hypotheses which will use up lots of time, but a controlled imagination which seeks for and formulates hypotheses which are likely to be fruitful; (3) inventiveness—a sufficient inventiveness to think of ways of working out those problems which he has framed; (4) an industry which is not to be turned aside by failure; (5) the quality of scientific honesty, which is not satisfied with half truths even if they are of immediate practical value and of personal advantage;[8] (6) a spirit of generous cooperation with other workers in similar lines." The achievements of the past have been largely through individual effort. The achievements of the future will depend more and more upon the efforts of men working from different angles upon the same problem.

The training of different groups of research workers will vary. "The epidemiologist," said Doctor Stimson, "should have a broad training in general pathology. * * * He should have training in economics and sociology and, lastly, in statistical methods." The clinical investigator presents a different problem. While it would seem as though an ordinary medical course should suffice, the facts of the case are that such a course not infrequently destroys the qualities which are necessary for successful research. The laboratory investigator need not go to a medical or public-health school. "The fundamental sciences of physics, chemistry, and biology will recruit fully as many valuable workers as the medical school or the public-health school."

How may the necessary qualities for research be developed by educational institutions? At the present time the amount of specific information to be assimilated by medical students is so great that little time is left for the development of their imaginative, inventive, and reasoning qualities. This pressure should be relieved perhaps by reserving more specialties for postgraduate study. There should, if possible, be more general employment of the inductive as opposed to the didactic method of teaching. More insistence should be placed upon a thorough grounding in primary physical sciences as an entrance requirement. But the development of research workers will depend far more upon the native qualities of the men attracted into the public-health field than upon any systematic education in medical or public-health schools.

Discussion: Dr. Vernon Kellogg, Dr. A. T. McCormack, and others.

In the discussion which followed, Dr. Vernon Kellogg, of the National Research Council, declared that while research is the privilege of genius, it is also open to any man of good intelligence and training. Others emphasized the importance of the character and personality of the public-health worker. "The spirit of service, so well typified by the old country doctor, must," said Dr. A. T. McCormack, State health officer, Kentucky, "also exist in the sanitarian of the future." Dr. M. P. Ravenel, of the University of Missouri, was for the practical man. "What we need," he said, "is a practical man—one who combines fundamental knowledge of these subjects with common sense and has the ability to put his knowledge into effect." It is important to remember, using Dr. Ferrell's words, that "the future of public health in the United States will be merely a reflection of the combined personalities and abilities of the men and women who engage in the work."

---

[8] Dr. William H. Park, New York City, who participated in the discussion of this paper, felt that this quality is particularly important.

IV. HOW MAY MORE AND BETTER SANITARIANS BE RECRUITED?

(Dr. Victor C. Vaughan, presiding.)

It was the general opinion of those attending the conference that at the present time an insufficient number of men of high quality are finding their way into the public-health field. No matter how effective and comprehensive the training provided in educational institutions, the result will be comparatively small unless men of ability are attracted. How may this be done?

Dr. Edwin O. Jordan, University of Chicago: Reasons given for not entering schools of public health.

In attempting to find an answer to this question, the conference was much interested in Dr. Edwin O. Jordan's paper detailing the results of a questionnaire which he distributed to the medical students of four different universities. "The questions," said Doctor Jordan, "were designed to bring out the student's reasons for entering a medical school rather than a school of public health and the reasons, if any, why public health seemed unattractive. Four hundred and sixty-one replies were received. One hundred and three students stated that they had at some time considered more or less seriously taking up public-health work. The others (358), who stated that they had never been attracted by and had not seriously considered entering public-health work, gave a variety of reasons."

1. Insufficient knowledge of the field: Twenty-three per cent of the 358 indicated that they knew little about the public-health field, and that it seemed to them of comparatively little importance. "I have known nothing about public-health work," wrote one. "I should have considered it probably seriously if I had known anything about it and might have entered it if it had been brought to my attention. I never heard of a public-health school, although I am a B. A. of Yale and an M. A. of Columbia." "There is no well-recognized school of public health in the United States," stated another.

2. Eighteen per cent of the medical students indicated a desire for personal contact with patients which they believed was possible more often in medical than in public-health work. "Medicine," frankly stated one student, "that is, general practice, gives the most opportunity to enjoy personality and gratify psychological curiosity."

3. Fifteen per cent of the students indicated their hostility to public-health work because of its too frequent contact with politics.

"Public-health work," said one, "is in the hands of politicians rather than of medical men who are actuated by idealistic motives." "Politics play too large a part, not only in obtaining jobs, but in prosecuting any project," declared another.

4. The question of remuneration is mentioned in a surprisingly small number of cases (nine per cent). Two quotations may be given. "The remuneration for a man who has spent nine or more years in preparation is inadequate in public health." "The compensation in medical practice bears some relation to your ability."

5. Nine per cent of the students find the tendency toward bureaucracy in public-health work distasteful. Many were apparently soured by their experience in the Army during the War. "There is always a suspicion of dulling the initiative in any Government position—saw too many Regular Army medical men during the War." "I prefer independence rather than the hierarchy of the Public Health Service. In other words I endured the life (as private) in the Army as a wartime duty and would not look forward to a lifetime of always recognizing a superior officer and being forced to 'drive' subordinates."

Some of the students feel that public-health work is simply a branch of medicine, and that it is part of the duty of the practicing physician. In the opinion of one student, "Public health is at present a branch science of medicine. The medical student receives nearly all of the training that a public-health student receives and much more. In an ideal state the medical man should be a public official and public-health officers should be medical men who have specialized in public-health work."

Other students do not hold public-health work and workers in high esteem. "I never heard of a school of public health that I would be willing to graduate from," wrote one. "The medical profession does not itself take public health and preventive medicine seriously. This is just as true at Harvard as elsewhere." "No physician with the ability to practice medicine would want to go into public health where the services can be competently performed by any good bacteriologist or laboratory technician who, with the help of a small office force, can get out a volume of vital statitstics per annum."

The conclusions from this study may be briefly summarized:

1. Many medical students are insufficiently informed concerning the nature and opportunities of public-health work. They are ignorant alike of the extent of the field and of the facilities existing for training.

2. Some students who are attracted to this field are deterred by fear of political interference, inadequate remuneration, and distaste-

ful living and working conditions. None of these objections are fundamental. They may be and must be corrected.

Dr. John A. Ferrell, International Health Board: How can the career of the sanitarian be made more attractive.

The preceding report of the reasons given by medical students for not entering schools of public health and public-health work should be a very valuable guide in any program for making the career of the sanitarian more attractive. The working conditions of the public health worker must be improved. "This will involve," said Doctor Ferrell, "the education of the public, of our legislative bodies and of many of the teaching and practicing members of the medical profession." Such education should include the following points:

1. Preventive medicine must be recognized as a distinct profession. It should be understood that a health officer requires special training; that a medical education alone will not suffice. Only trained sanitarians should be engaged as health officers and the qualifications required should be such as to limit appointees to this group.

2. The people should be acquainted with the striking achievements of preventive medicine. Concrete examples of what has been accomplished should be used to drive the lesson home to the people. To use Doctor Ferrell's words, "When the public is thoroughly informed as to the benefits attending the successful application of preventive medicine, and realizes the extent of the training that is requisite for such application, there is no question but that it will insist upon conditions of public-health service being made at least as attractive as in corresponding professions such as law, medicine, or engineering. * * * It will realize that the work will attract the best type of young men and young women when, and only when, the field is free from harmful political influence and when there is reasonable prospect that appointment, compensation, and tenure will be based upon merit alone." In order to remove public-health positions from politics, Doctor Ferrell suggested that nonpartisan boards, such as now in charge of our educational systems, should be established for public health. "With such a board," he said, "there is less danger that the changing fortunes of political parties will cause competent workers to lose their positions or be neglected in the matter of promotion."

3. Health work must be made efficient. "Unless efficient service is rendered, it is not reasonable to expect that funds will continue to be supplied or that satisfactory conditions of service will continue to be maintained. * * * If the health officer is to command the support of professional men, his scientific procedure must be sound; if business men are to respect him, his efforts must be productive and his methods neither wasteful not extravagant. Where convincing

demonstrations have been conducted, the public has shown a willingness to give the health officer a generous backing to carry out his policies."

4. The opportunities for research and investigation should be multiplied. To many students, especially those of highest caliber, much of the attractiveness of a profession depends upon the possibilities for research work. Where the possible achievements for research are large, as in the public-health field, there is a particular desire for this opportunity.

If these steps are carried out, if the public realizes that preventive medicine is a distinct professional field for which our medical schools at present fail to supply the requisite training, if the value of public-health service is recognized and freed from harmful political influences, if the efficiency of public-health activities is convincingly demonstrated, leading to a more generous compensation scale, and if the opportunities to participate in broadening the horizon of our knowledge of preventive medicine and its effective application are increased, a sufficient number of high-grade sanitarians should easily be recruited.

Discussion: Dr. Frank J. Goodnow and Dr. L. L. Lumsden.

In the discussion which followed Doctor Ferrell's paper, Dr. Frank J. Goodnow, president Johns Hopkins University, declared that in order to change the attitude of the public toward public-health work four things must be done: (1) Public-health administration must be more efficiently organized. (2) Public-health practice must be made sound. In the past too many false steps have been taken. (3) The character of the public-health officers must be given careful attention. (4) The demands for social protection and for individual rights and freedom must be reconciled. "I feel very strongly," he said, "that a large part of this problem can only be solved after we have solved the administrative side of it."

Dr. L. L. Lumsden, of the United States Public Health Service, made three suggestions regarding the supply of sanitarians. (1) He would have the local health officer realize to a greater extent the value of the work he is doing. (2) He would lead people generally to a greater appreciation of the services rendered, and thus secure a higher standard of compensation. (3) He would spread the idea that through public-health work a man may render the very highest type of patriotic service.

As will be seen, this subject was given further attention at the round-table discussion.[9]

---

[9] Pages 33-34.

V. HOW SHALL THE SANITARIANS OF THE FUTURE BE TRAINED?

(Dr. Hugh Cabot, presiding.)

Dr. Hugh Cabot, University of Michigan Medical School, Chairman.

Having considered the kind of sanitarians needed and ways in which more and better sanitarians may be recruited, the conference directed its attention to the practical question: How shall the sanitarians of the future be trained? "Obviously," stated Doctor Cabot, "the simple development of desires and the necessities of a situation do not get us very far. The important thing is for us to say what beginnings can be made, what possibilities there are of laying a foundation for the desirable things which have been suggested. After all, these efforts must be made through the established lines of communication, through machinery which exists. It is probably not desirable to set up new machinery. It is certainly not likely to be possible, and it therefore comes down to a question of what uses can be made of existing machinery and how those charged with the broad questions of education are going to take up their task."

Dr. James R. Angell, Yale University: What may the universities do to meet the need for more and better trained sanitarians?

What may the universities of the United States do through their various colleges to meet the demand for more and better trained sanitarians? "In a sense," said President Angell, "they can do everything. The only aspect they can not handle is what may be called field service, where all they can do is to furnish guidance and suggestions."

"Possibly not the least of the services which universities can render," continued Doctor Angell, "is to be found in a broader emphasis on their part upon the character and extent of the demand for men in public-health work. * * *

"It is reasonable to believe that at present university men are quite inadequately informed regarding the opportunities open to sanitarians and public-health workers. As a result relatively fewer students give serious consideration to this calling in choosing a career than might well be the case. Medical students, to be sure, are apt to have some knowledge of this field, but as a general rule their information is fragmentary and oftentimes far from correct. This fact, together with a frequently unsympathetic attitude on the part of their instructors and the belief that the financial and professional rewards are unsatisfactory, serves to discourage any possible disposition on their part seriously to consider this calling. It is a common shortcoming of our American colleges and universities, which many of them are attempting to overcome, that they give their students so meager and so unreliable guidance concerning the choice of a vocation.

The failure to do this in the case of the work of the sanitarian is therefore but one instance of a general defect which can, however, as regards this special field, be rapidly overcome by a moderate amount of judicious effort.

"Perhaps the most urgent immediate need is a fairly sharp definition of the standards to be upheld in public-health work, both as regards the personal qualifications of those who should be permitted to enter upon it and as concerns the professional training to be required. If clean-cut standards and qualifications can be established, it may be confidently expected that medical men in particular and the thoughtful public in general will come to accord a position of respect and confidence to this relatively new profession which at present it does not uniformly enjoy."

In providing training for a public-health career within the university there will be need for a considerable amount of cooperation between various departments. It should be practicable even in institutions in which a separate department of public health is impossible to provide a considerable amount of the necessary training. Such training may, indeed, be in large measure of a preliminary character, a foundation for subsequent attendance at a specialized public-health school. Many of the small colleges through the country can provide this preliminary training.[10]

It was Doctor Angell's belief that the first two years of the ordinary college course would require very little modification in order to provide a suitable foundation for public-health training. He suggested, however, "a conspectus course" dealing with social organization and social problems. This would have two purposes: To acquaint students with the social and economic problems which are inextricably bound up with the problem of public health and to give them what may be called a social point of view. While the physician, as generally conceived, looks at things from an altogether individual point of view, the public-health worker must constantly keep in mind the welfare of the larger social unit. A course such as that proposed, early in the training, would at least introduce this point of view.

In the case of the premedical subjects, it may be desirable to provide that they be presented as far as possible from the public-health point of view. This can not be demanded, but must be secured by cooperation with the departments concerned. In most cases a duplication is unjustifiable.

"There is a considerable body of thoroughly solid technique connected with the field of applied psychology," said President Angell, "which can be made of distinct significance in connection with a public-health program. Some familiarity, both theoretical and practical, with the methods of identifying subnormal mental stock, some familiarity with the technique of the classification of personnel in its relation to both educational and industrial processes will be of substantial value." Doctor Angell briefly alluded to the great opportunities for the application of psychological principles in the field of popular instruction concerning health matters, a subject touched upon at an earlier session of the conference. This instruction can not be given in a scientific manner unless the principles of psychology are applied.

---

[10] "Every university and every college in this land," said Dr. Victor C. Vaughan in the discussion, "is already fitted to make men competent to do work along some of these lines."

It is clear that the relations between the program of public-health training and the program of medical training must be very close. In Doctor Angell's opinion there are a number of good reasons for urging that the professional sanitarian or public-health officer should hold a medical degree.

In conclusion he said: "Viewing the situation as a whole, it would appear that the great body of the training material required for meeting the demands of any of the ideals now entertained for public-health workers could be met by the larger universities which have engineering schools and medical schools. Not a little of the training now offered is directly and immediately available, and most of the rest could be obtained by reasonable and moderate changes in the present courses of study offered. In a few instances there will be the need of introducing outright new work, and from beginning to end there will be the necessity of animating the entire program with the professional spirit of public service. Even though the sanitarian enter the employ of a private corporation, the work required can not be successfully accomplished in any spirit except that of a large regard for the general public welfare. Carried on in such a spirit surely there are few professions open to the young men of to-day that hold out more of stimulation and inspiration to bring to the service of the community the best powers of trained intelligence and modern science."

Dr. George C. Whipple, Harvard University: A proposed curriculum for a school of public health.

It is to be expected that there will be a considerable increase in the number of schools of public health in the future. While universities may provide considerable training through the coordination of courses already existing in the curriculum, a special school will be necessary for more advanced work. Doctor Whipple declared that two types of training corresponding to the different types of workers must be provided. In the first place opportunity must be given for students to specialize in various fields of public-health work in which special training is not offered elsewhere. This is so obvious as not to require further elucidation.

The second function of the public-health school is to provide men for administrative positions. Here a "broader and more uniform training in the interest of cooperative effort, and in order that uniformity of administration may result in better enforcement of public-health laws and regulations," is needed. The public-health administrator must have the ability, quoting Doctor Whipple, "to view the community as a whole, to visualize community health from statistical data, to think in terms of the mass instead of the individual, to estimate quantitatively the effect of environmental conditions, and to appraise the benefits to be derived from expenditures of money for public-health purposes." This ability may be developed by the school of public health to a certain extent through special courses. More than this is needed however. "Unless the spirit which pervades a school of public health is different from that which exists, and which should exist, in a medical school, it will prove to be a useless addition to our educational institutions. Physicians should be trained for personal, individual service; health officers should be trained for community service. * * * The spirit of the school and the controlling desires of its dominating instructors are far more important than any program of studies and should receive first attention. The studies pursued in a school of public health should be so chosen and apportioned as to time that the students will acquire this spirit of community health."

Professor Whipple was of the opinion that the apportionment of time for different subjects should depend upon their difficulty and not upon their relative importance in after practice. Experience has, he believes, revealed that statistics, sanitation, and laboratory courses are particularly difficult for the man who specializes in public health. He would, therefore, devote a rather large amount of time to these studies.

The importance of personal contacts was emphasized. A teacher, such as the late Professor Sedgwick, who will inspire the students, is necessary in every school of public health. It makes little difference what subjects he teaches; all should have the opportunity to come under his influence.

There is considerable danger in the program of a school of public health as in a school of medicine to crowd the students. "Whatever course we lay out for the student," said Professor Whipple, "let us not make it a race course. At least a tenth of the student's time should be left free for the studies of his own choosing."

The following program for a one-year course may be suggested:

	Per cent.
First term:	
Laboratory courses—	
Bacteriology	25
Sanitary chemistry and biology	25
Lectures chiefly—	
Vital statistics	20
Hygiene	10
Law and legislation	10
Elective	10
Second term:	
Laboratory courses—	
Applied hygiene	25
Epidemiology	25
Lectures chiefly—	
Preventive medicine	20
Sanitary engineering	10
Public-health administration	10
Elective	10

As will be seen, there are five leading subjects, each of which is carried throughout the year: Hygiene, sanitation, preventive medicine, statistics, and public-health administration. Courses involving laboratory work should be conducted on the intensive plan. Probably about half the time would be spent in the laboratory.

No academic training will adequately prepare a student for a career in public health. Practical experience in the field is essential. This point was touched upon by a large number of speakers at the conference and a considerable number of practical suggestions were made.[11] Doctor Whipple's contribution was the suggestion that a sanitary survey is an excellent means of rounding out a course. This should be done, in his opinion, after the year's work and not during the term, when the student is very busy with his regular studies. To carry on such a survey during the term is to deprive the student of practically all his leisure time.

The danger of standardizing the curriculum of public-health schools was mentioned by Professor Whipple. Doctor Rosenau has stated it in this way:[12] "While a certain amount of academic authority is desirable, especially with reference to requirements for degrees, on the other hand, it would be a serious mistake to provide for a fixed system of curricula and degrees that would force health education into rigidity. The present status calls for freedom, elasticity, and individuality. The method of training health officers seems well crystallized out of our short experience, but we should take the attitude that the best method is still to be discovered."

---

[11] See pp. 31-32.

[12] See p. 5.

Discussion: Dr. Victor C. Vaughan, Dr. A. C. Abbott, Dr. Annie Goodrich.

This point was emphasized a number of times during the conference. Dr. Victor C. Vaughan, of the National Research Council, said: "If we are going to standardize public-health courses in this country, lay down cast-iron rules that a man must do this and a man must do that before he can occupy a position as health officer, then we are doing harm."

One group of sanitarians whose training had been neglected by previous speakers was discussed by Dr. Annie Goodrich, Teachers's College, Columbia University. The nurse and nutrition worker both occupy very important places in any comprehensive scheme for the improvement of public health. Above all else the nurse is a teacher. "She must," said Doctor Goodrich, "teach the people with whom she comes into contact the causes of disease and how disease may be avoided. She is the most important connecting link between the expert specialist on the outside and the family on the inside." More and more college women must be encouraged to enter this field. "There should be," continued Doctor Goodrich, "not less than two years in college for the nurse or nutrition worker."

Continuing the discussion, Prof. Alexander C. Abbott, of the University of Pennsylvania, told of his practical experience in coordinating the different departments of the university for the preparation of sanitarians. He began this effort as far back as 1906. It was not a simple or easy process. Nevertheless, he did succeed in arranging a fairly coordinate course which has been improved from year to year. Doctor Abbott felt that this plan might be adopted in a much larger number of smaller colleges than have up to the present time given the matter any attention. He recognized, however, a considerable disadvantage in that the coordination does not create the best sort of atmosphere for public-health training.

Dr. Roger Perkins, Western Reserve University: The education of the partially trained sanitarian now employed.

An entirely different problem from that of the preparation of new workers for careers in public health is the problem of the education of the partially trained sanitarian now employed. With the extremely rapid expansion of the public-health field which has been discussed and the prospect of continuing expansion in the future, it will be necessary for the worker in this field to be on the watch constantly for new information and training. To quote Doctor Perkins: "This is not merely a very pressing need of to-day, it is need which will continue. No man who is worthy of his hire will ever feel satisfied no matter where he has obtained his preliminary training. He will want more training; want to get further advancement."

Unfortunately there are several obstacles to the education of the partially trained sanitarian. The first is the attitude of the individual himself. As Doctor Perkins effectively phrased it, "There are many men who do not appreciate that they do not know as much as they might know if they knew more, and these men will not come forward and clamor for instruction." A still greater difficulty is lack of time. In some way or another provision must be made so that an official who desires to take time for special training may receive a leave of absence.

Three distinct methods of further training are possible:

1. The brief institute.
2. The university course of longer duration in connection with a school of hygiene, or a department of hygiene and preventive medicine.
3. The correspondence course.

The institute usually lasts about a week and may be held in almost any city. Its staff is made up of a combination of local health officials and a peripatetic group of experts. The great disadvantage of this method is the high concentration of the work given. "It is hard for the human mind," said Doctor Perkins, "to absorb a large amount of material in a limited period, and there is great lack of time for the demonstrations and visits to installations which are so helpful in study."

Doctor Perkins himself feels that the second alternative—the longer course in connection with the department of hygiene of a university—is most promising. It will have capable teachers and excellent facilities. It will be possible to limit closely the number of subjects taken up at a single time. Of course, comparatively few universities are in a position to offer this work, but the success of similar courses for medical men seems to justify the application of this method to the public-health field wherever possible.

The correspondence course is usually under State control and is less expensive. It permits uniformity of teaching. The lack of personal contact is, however, a serious disadvantage and this alternative should be employed only as a last resort. Under the present circumstances it would be best to make use of all three alternatives.

If the longer course in connection with universities is to be successfully developed, two steps must be taken. Public authorities must be educated to an appreciation of the value of such courses to the efficiency of their public-health department. They must realize the necessity of granting a leave of absence to their workers for this purpose. The second necessity is financial assistance to the university departments undertaking the work. The present staffs can not be expected to assume this additional burden without being relieved of more routine matters.

Cooperation between the university department of hygiene and the local health department, in Doctor Perkins' opinion, would offer mutual benefits. If the university is to secure assistance from the municipality in the practical training of its students, it should be ready to offer something in return. For instance, its library facilities should be made available to all workers of the health department. It should do more than this; it should stimulate the use of these facilities. Considerable success has attended efforts in this direction in Cleveland.

The discussion of these papers on the training of sanitarians was led by two experienced health officers, Dr. Eugene R. Kelley, of Massachusetts, and Dr. S. J. Crumbine, of Kansas.

Discussion: Dr. Eugene Kelley and Dr. S. J. Crumbine.

Doctor Kelley introduced himself as a horrible example of the health officer without a technical training. He declared, however, that he had graduated from the "university of hard knocks in public health," which provides training which is perhaps more important than the technical training of a school of public health. In some respects technical training is a disadvantage. It prevents one from "rushing in where angels fear to tread." Doctor Kelley vigorously opposed any extension of the English system of state medicine to this country. "I deprecate efforts to get more physicians working for the State," he said.

The training of the part-time public-health officer should receive more attention, in Doctor Crumbine's opinion. He told of the efforts in this field which had been made in Kansas. Each year the county health officers are brought together for a week of instruction, which gives them a better idea of the modern public-health movement. They in turn help to educate their constituencies. This is of great importance in these days when the reduction of governmental expenditure is so generally demanded.

VI. ROUND TABLE.

(Frank J. Goodnow, presiding.)

An opportunity was given in the round table, conducted by President Frank J. Goodnow of Johns Hopkins University, for a general discussion of questions which had developed at the earlier sessions. The first question proposed for consideration was: How may the school of public health provide for its students experience in practical health work? Or, as Doctor Goodnow preferred to state it: How can the health departments in which the practical work is done cooperate with the school of public health in providing opportunities for practical work for the students? This question was mentioned by several speakers, but by bringing it forward for general discussion a considerable number of practical suggestions were secured.

Dr. Haven Emerson, New York.

Several of the speakers called attention to the possibility of the cooperation of municipal or local health departments. "I should say," said Doctor Emerson, "that it is as indispensable for a school offering a course in public health to have a section of the city and rural community to study for its laboratory, its training ground, and its clinic as it is for the university medical school to have its hospital to teach diagnosis of the individual sick. Universities should at once busy themselves by making an affiliation with the health officer of the city in which they are located." Doctor Emerson told of what has been accomplished at Western Reserve University in Cleveland. There one-eighth of the city is set apart as the university district. The community benefits from the voluntary service which is provided and the students get practical training.

Dr. W. C. White, National Tuberculosis Association.

The Public Health Service as a possible training ground for workers was suggested by Doctor White among others. "If there were any resolutions to be offered by this body," he said, "I would suggest this: That the Public Health Service take students at the expense of the organization which has these students, either in the university or under employment, into active fields of work for intensive study and practical training." State organizations could do likewise. Earlier in the conference, Dr. M. P. Ravenel had said: "We have in our Public Health Service the largest and best trained body of sanitarians in the world, engaged in public-health activities of every sort. Surely, some plan can be formulated by which students can be placed in different divisions of the service for practical training."

Dr. William F. Snow, American Social Hygiene Association.

An obstacle to this form of training was mentioned by Doctor Snow. He declared that there are plenty of opportunities for the health officer or individual who is in a position to finance himself during the period of practical training. Difficulty arises when it is necessary to secure a leave of absence for a man already at work. It was impossible, for instance, for the State of Louisiana to send men to San Francisco for training in fighting plague because no salary or even expenses could be paid to a man who was outside the State. The only way in which this obstacle may be overcome is through a process of public education.

Dr. H. R. Carter, United States Public Health Service.

Doctor Carter mentioned some of the work which the United States Public Health Service has already done in this field. In malaria control it has been the practice to take on men from different States for a limited period, paying them as workers and to release them, when well trained, to the States. This has proved very effective. A considerable number of those who are now handling the malaria problem in the various States received training at the expense of the Public Health Service.

Dr. G. B. Young, United States Public Health Service.

"The first real attempt to do anything of the sort," said Doctor Young, "was made by Dr. William A. Evans, health commissioner of Chicago, when he organized in his department a school of sanitary instruction." This school endeavored to give training in the practical work of the sanitary inspector, food inspector, and the like. "It is absolutely essential," continued Doctor Young, "for the man who is studying in the public-health schools to have the advantage of instruction in the field. The best way for him to get it is through the larger health departments, not only the municipal, but also the State departments."

Dr. William H. Welch, Johns Hopkins University.

"At Johns Hopkins," said Doctor Welch, "we require that there be at least three months' practical training of this kind. * * * A first-class school of hygiene should have attached to it and at its very door a training area, which is just as necessary for students of hygiene as is the teaching hospital for students in schools of medicine. You can not expect the money that is available for the municipal and State boards of health to be available for all the purposes for which you would use such an area—for making certain demonstrations, experiments, studies, and collection of data." Doctor Welch suggested that if a special area could not be otherwise secured, the university group itself might be used as a training ground.[13]

Dr. O. P. Geier, Cincinnati Milling Machine Co.

The opportunities for practical training in connection with industrial establishments were pointed out by Doctor Geier. "Here we have," he said, "a small unit, but almost all the problems of the large city health officer: Food supplies, milk supplies, water supplies, and sewage disposal. In addition we have the human element. * * * Besides the human equation entering into the industrial work, there is the contact with men and the development of the ability to sell health to the average man. After all, this is a thing that the health officer is going to have the most difficulty to comprehend: How he may get his message of good health to appeal to the common man."

Dr. A. T. McCormack, Kentucky State Board of Health.

Doctor McCormack emphasized the importance of reaching "the man at the end of the trail." "We are compelled," he said, "to provide the kind of health officer who can speak in the vernacular and transmit the things our leaders already know." Doctor McCormack emphasized what he called the art of public-health officering.

---

[13] Doctor Edsall indicated that something of this sort was being done at Harvard. "It (the university health organization) can be used as a very striking demonstration of the results that can be accomplished by public-health work where you can work out a more or less ideal plan."

The second question brought before the round table was this: "What specific steps may be taken to bring before college students in general and medical students in particular the opportunities for service in public-health work?"

Dr. George M. Kober, Georgetown University Medical School.

Doctor Kober felt that the interest of medical faculties would accomplish much and he suggested that an attempt be made to persuade medical faculties to make their professor of hygiene dean of the faculty.

Dr William Keiller, University of Texas.

Doctor Keiller proposed that the United States Public Health Service issue a pamphlet for continuous display in the library of medical schools. Such a pamphlet, he said, should set forth the opportunities in the Public Health Service, the opportunities in city and State health work, the present schools which give special courses in public health, and so on.

Dr. D. W. Davis, College of William and Mary.

Something should be done to interest undergraduates, in Doctor Davis's opinion. He maintained that the field of public health has one great advantage over the field of medicine, namely, that a man may do creditable work in public health after he has had not more than four years of study altogether, whereas in the medical profession at least six years is necessary. He believed that any information distributed should be sent to colleges as well as medical schools, and that included should be a statement concerning the possibility of doing good work in various phases of public-health work after a comparatively limited amount of training.

Dr. Charles W. Stiles, Hygienic Laboratory.

A new note was put into the discussion by Doctor Stiles. "I would like to state," he said, "that after 31 years in public-health work I consider the greatest opportunity before the student of public health is that of making personal sacrifice. No man should enter public-health work with the idea of any grand opportunities before him. They do not exist. There is only one opportunity, and that is the opportunity of personal sacrifice."

Dr. Louis I. Dublin, Metropolitan Life Insurance Co.

Dr. Louis I. Dublin indicated the necessity of developing a great mass of public-spirited citizens interested in health problems. "The difficulties which arise for the health officer," he said, "arise chiefly from the lack of an educated body of citizens." He called attention to the fact that there are almost 400,000 boys and girls in the colleges of the country and that many of these become community leaders. They should be prepared, not so much for health work, as for leadership of intelligent public opinion. By correlating existing courses of the curriculum, it would be possible to create such an interest in public-health matters.

Dr. Robert Wilson, jr., Medical College of the State of South Carolina.

Doctor Wilson frankly stated that the "atmosphere of medical colleges as a rule is antagonistic to public health. Health officers meet opposition instead of sympathy and cooperation among the physicians with whom they have to work. In South Carolina a systematic course in public health is given each year by the State health officer." This plan Doctor Wilson thought should be widely applied.

Dr. John Milton Dodson, University of Chicago and Rush Medical College.

"Our health clinical curricula must have from start to finish a strong emphasis on the possibilities of prevention," declared Doctor Dodson. "We must teach a generation of medical students how enormously greater are the possibilities of prevention than are the possibilities of cure. This can be brought about in one way only, by addressing the medical faculties themselves."

It was suggested by Dr. W. C. White that the Public Health Service send through the medical schools lecturers explaining to the students the possibilities in public-health work.

Unfortunately, the conference was unable to devote more time to round table discussion. The value of this method was evident. Probably more practical suggestions for the training of sanitarians were offered in this way than in the formal papers. Many of these suggestions are worthy of careful consideration.

VII. CONCLUDING ADDRESSES.

(Frank J. Goodnow, presiding.)

Dr. Ray Lyman Wilbur, Stanford University: The university of the future — A recruiting and training center for the public-health professions.

If the university of the future is to be a recruiting and training center for the public-health professions, present educational institutions, in Doctor Wilbur's opinion, must undergo a considerable transformation. To-day most of the subjects taught in our colleges are not concerned with public health. "There is a good deal more talk about the 'War of Roses,'" he said, "than there is about spontaneous generation or any of the other things which concern us a great deal. The university with which I am connected is one of the few which require biology for entrance. And yet, how can you say any man is educated who does not know biology? * * * We must conceive our education from an entirely new angle. We must talk of it not in the terms of to-day, but with the idea that we are trying to get people ready for 20 years from to-day. We can not do that by teaching things that were already 40 years old in 1880."

In the colleges of the country will be found a large proportion of the leaders of the future. We must give these potential leaders a worth-while education, an education which will fit them for the work which they are to do in the world. This will include a consideration of the sciences upon which public-health work is based. "So," concluded Doctor Wilbur, "will we be able in 20 years from now to present achievements in public health that are now undreamed of."

Dr. Lewellys F. Barker, Johns Hopkins Hospital: Public health and the future commonwealth.

Doctor Barker also was enthusiastic concerning the possibilities of public health work in the future. "Many in attendance at this conference," he said, "are of the opinion that within a comparatively short time public-health activities will far exceed those of to-day, both in intensity and in range. They feel sure that in this country, at least, the environment will speedily be made more wholesome, that the mass of the people will be led up the scale of personal hygiene and efficiency, and that, possibly, also the germ plasm of Americans may be gradually improved."

Only within a relatively short time have the public-health services entered the fields of diagnostic and curative medicine. To quote Doctor Barker again: "Experience with public medical and nursing services for maternal and child welfare, for the health of school children, for the early recognition and prompt treatment of certain infectious diseases, especially tuberculosis, gonorrhea and syphilis * * * would indicate that public health workers will from now on become ever more active in diagnostic and curative domains.

"Again, the growing conviction that the maintenance of physical and mental health of individuals is definitely related to the industrial, the social, and the economic conditions in which they find themselves would make it seem likely, too, that in the near future the public-health service will be compelled to play a rôle in the invention and application of contrivances that will insure for every person in the commonwealth standards of living that are not incompatible with the preservation of health or the maintenance of an abounding vitality. * * *

"Further, the eugenic problem has as yet been scarcely touched by public-health workers. * * * As environmental improvements keep alive the biologically less fit, should we not see to it that arrangements be made for the encouragement of parenthood by the 'more fit,' for the discouragement of parenthood by the 'less fit,' and for the prohibition of parenthood by the 'notoriously unfit.'"

It is clear that this expansion of public-health work will bring large returns in the future. The chief problem of the present, however, is to apply the information which is at hand. Public-health workers must act as intermediaries between the scientists and the common man. The facts disclosed by science must be told in a way which will be understood by the masses. This will go far toward the protection of people from health fads and fancies and from quacks and charlatans.

Doctor Barker warned against fixed aims. "* * * In planning their work in the future commonwealth," he said, "public-health workers will require periodically to revise their euthenic and eugenic aims in the light of extending knowledge. At each revision the program should be considered from two points of view, the individual and the racial. * * * Americans have been called the 'people of action'; but is action always preceded by sufficient thought and investigation?" Research must continue indefinitely.

"It is certain," concluded Doctor Barker, "that this conference will be found to have done much to increase the interest in public-health functions, to stimulate the investigation of public-health problems, and to enlarge materially the number of men and women desirous of engaging in public-health work."

The task of recapitulation was placed upon Doctor Edsall, who also acted as chairman of the committee on recommendations.

Dr. David Linn Edsall, Harvard University: Recapitulation.

Doctor Edsall devoted considerable attention to the question of securing additional recruits for work in the public-health field. With Doctor Dodson, he felt that the essence of the difficulty lies in the attitude of the medical faculties toward preventive work. "I do not believe," he said, "that we shall get much change in the attitude of the medical student until we can change the attitude of the medical faculties." Even more important, perhaps, is the change in the attitude of the undergraduate faculties. Large numbers of students are guided in their choice of a career by the advice of their professors. The professor of physics, of chemistry, of English, of government must realize the opportunities in the public health field and bring them to the attention of his students. At Harvard special efforts are being made in this direction.

Two points in regard to the methods of educating sanitarians, Doctor Edsall felt, should be emphasized. A very serious danger of overcrowding the courses, and so destroying individual initiative on the part of the students exists. "We must," he said, "avoid crowded conditions in teaching public health." Again, public health education should not suffer from overstandardization. There must be different types of schools to develop the different types of men which will be needed.

In Doctor Edsall's opinion one point had not received sufficient attention. This was the matter of the financial return from public health activities. To quote his words: "We must have such exact knowledge that the economist will accept it—knowledge on which he can base actual recommendations for a course of action. Scientific economic studies are of utmost importance, particularly in convincing legislators, large philanthropists, and persons of that kind as to the needs for money, not based upon ideals, but upon actual practical facts." Economists and other professional men must be interested in public-health work.

The committee on recommendations, through Doctor Edsall, presented the two following resolutions:

That the Congress of the American Medical Association on Medical Education, Medical Licensure, Public Health, and Hospitals be urged to include a section on the education of health officers and sanitarians.

That the Surgeon General of the United States Public Health Service be requested and empowered to appoint a committee including Dr. C. C. Bass, New Orleans; Dr. W. H. Howell, Baltimore; Dr. A. J. McLaughlin, United States Public Health Service; Dr. E. O. Jordan, Chicago; Dr. M. J. Rosenau, Boston; Dr. R. L. Wilbur, Palo Alto; Dr. Ennion Williams, Richmond; Dr. C.-E. A. Winslow, Yale; Dr. D. L. Edsall; the committee to enlarge itself to 15, and that this committee consider whatever questions it sees fit and take whatever further action for future conferences may seem wise in order to continue the activities that this conference has started.

These resolutions were adopted.

Following the passage of a resolution of thanks to the Public Health Service for arranging the meetings and a brief statement by Surgeon General Cumming in appreciation of the attendance of those who came, the conference adjourned.

No report has been included in this résumé of the dinner on Tuesday evening. Aside from the pleasant sociability of this occasion, three interesting and stimulating talks were delivered. Dr. Livingston Farrand spoke upon the human and economic costs of preventable disease. He indicated that not only is the development of modern civilization handicapped by this heavy burden, but also that its future is actually endangered. Active, energetic, and continuous efforts are demanded to avoid disaster. Dr. C.-E. A. Winslow contrasted the health officer of the past with the health officer of the future. He outlined some of the opportunities and responsibilities confronting the latter The health officer of the future, he said "will be prophet as well as priest and king. It will not be enough merely to inspire and to lead along the established paths. New possibilities will be opening during the coming years." The final address was by Dr. George E. Vincent. Doctor Vincent effectively pointed out the danger of becoming too visionary and emphasized the importance of going forward with the tasks already at hand. His talk was eloquent and stimulating.

APPENDIX.

MEMBERS OF THE CONFERENCE.

PRESIDENTS OF UNIVERSITIES.

Angell, James R., Ph. D., LL. D., president, Yale University.
Chandler, J. A. C., LL. D., president, College of William and Mary.
Durkee, J. Stanley, M. D., president, Howard University.
Farrand, Livingston, M. D., president, Cornell University.
Goodnow, Frank J., LL. D., president, Johns Hopkins University.
Rhees, Rush, LL. D., president, University of Rochester.
Wilbur, Ray Lyman, M. D., LL. D., president, Stanford University.
Woods, Albert F., D. Agr., president, University of Maryland.

DEANS AND DIRECTORS OF SCHOOLS OF PUBLIC HEALTH, HYGIENE AND MEDICINE.

Abbott, Alexander C., M. D., director, school of hygiene and public health, University of Pennsylvania.
Allison, Nathaniel, M. D., dean, Washington University School of Medicine, St. Louis, Mo.
Bardeen, Charles Russell, M. D., dean, school of medicine, University of Wisconsin.
Cabot, Hugh, M. D., dean, University of Michigan Medical School.
Dodson, John Milton, M. D., dean of medical courses, University of Chicago and Rush Medical College.
Doughty, W. H., jr., M. D., dean, medical department, University of Georgia.
Edsall, David Linn, M. D., dean of the medical school and school of public health, Harvard University.
Gile, John M., M. D., dean, Dartmouth Medical School.
Halsey, John J., secretary, school of medicine, Tulane University of Louisiana, New Orleans, La.
Hart, C. D., associate professor public health, College of William and Mary, Williamsburg, Va.
Keiller, William, acting dean, medical branch, University of Texas, Galveston, Tex.
Kober, George M., M. D., dean, Georgetown University Medical School.
Lyon, E. P., M. D., dean, medical school, University of Minnesota.
MacCracken, W. H., M. D., dean, Detroit College of Medicine and Surgery.
McElroy, James B., M. D., president of faculty, College of Medicine, University of Tennessee.
Miller, E. C. L., M. D., dean, Medical College of Virginia.
Page, Henry, M. D., dean, College of medicine, University of Cincinnati.
Pearson, W. A., M. D., dean, Hahnemann Medical College.
Robinson, G. Canby, M. D., dean and professor of medicine, Vanderbilt University Medical School.
Rowland, J. M. H., M. D., dean, medical department, University of Maryland.
Schmitt, L. S., M. D., acting dean, University of California Medical School.
Schulte, H. von W., M. D., dean, Creighton University College of Medicine.
Tracy, Martha, M. D., Dr. P. H., dean, Woman's Medical College of Pennsylvania.

Welch, William H., M. D., director, school of hygiene and public health, Johns Hopkins University.

Whipple, George H., M. D., dean of the school of medicine and dentistry, University of Rochester.

Wilson, Robert, jr., M. D., dean, medical College of the State of South Carolina.

Woody, McIver, M. D., dean, Baylor University College of Medicine.

PROFESSORS OF PUBLIC-HEALTH SUBJECTS AND OTHER EDUCATORS.

Baketel, H. Sheridan, M. D., professor of preventive medicine and hygiene, Long Island College Hospital.

Barker, Lewellys F., M. D., medical department, Johns Hopkins Hospital.

Bolt, Richard B., M. D., Baltimore, Md.

Davis, Donald W., professor of biology, College of William and Mary.

Emerson, Haven, M. D., Cornell School of Hygiene, New York.

Freeman, Allen W., M. D., resident lecturer, public-health administration, school of hygiene and public health, Johns Hopkins University.

Garcia, Maj. Leon C., United States Army, professor of military science and tactics, St. Louis University School of Medicine.

Goodrich, Annie, D. Sc., teachers college, Columbia University.

Hayhurst, E. R., M. D., professor of public health, Ohio State University.

Haythorn, Samuel R., M. D., director of hygiene, University of Pittsburgh.

Howell, W. H., M. D., assistant director, school of hygiene and public health, Johns Hopkins University.

Jackson, Algernon T., M. D., professor of public health and hygiene, Howard University School of Medicine.

Jordan, Edwin O., Ph. D., professor of bacteriology, University of Chicago.

Leigh, Robert D., lecturer, Columbia University, New York City.

Mabon, T. McC., M. D., instructor in hygiene, University of Pittsburgh.

Meredith, Florence, M. D., professor of hygiene, Woman's Medical College of Pennsylvania, Philadelphia, Pa.

Mitchell, O. W. H., M. D., professor of bacteriology and hygiene, Syracuse University.

McCollum, E. V., M. D., professor of bio-chemistry, School of Hygiene and Public Health, Johns Hopkins University.

Perkins, Roger G., M. D., professor of hygiene, School of Medicine, Western Reserve University.

Park, William H., professor of bacteriology and hygiene, University and Bellevue Hospital Medical College, New York, N. Y.

Ravenel, Mazyck P., professor of bacteriology and preventive medicine, School of Medicine, University of Missouri.

Rosenau, Milton J., M. D., professor of preventive medicine and hygiene, Harvard Medical School.

Rosenberger, Randle C., M. D., professor of hygiene and bacteriology, Jefferson Medical College, Philadelphia, Pa.

Rushmore, Stephen, M. D., associate professor of gynecology, Tufts College Medical School, Boston, Mass.

Sears, Dr. Heber J., professor of hygiene and preventive medicine, University of Utah, Salt Lake City, Utah.

Seashore, Carl E., Ph. D., chairman, division of anthropology and psychology, National Research Council, and dean of the Graduate College, University of Iowa.

Smith, Richard M., M. D., instructor in pediatrics, Harvard University Medical School, Cambridge, Mass.

Sundwall, John, Ph. D., M. D., director, division of hygiene and public health, University of Michigan, Ann Arbor, Mich.

Torrey, Harry Beal, Ph. D., professor of biology, University of Oregon.

Trotter, Dr. Frank B., University of West Virginia.

Turner, C. E., assistant professor of biology and public health, Massachusetts Institute of Technology, Boston, Mass.

Walker, Elton D., professor of hydraulic and sanitary engineering, Pennsylvania State College, State College, Pa.

Whitmore, Eugene R., M. D., Dr. P. H., professor of bacteriology and preventive medicine, George Washington University, Washington, D. C.

Whipple, George C., S. B., professor of sanitary engineering, Harvard University, Cambridge, Mass.

Williams, Jesse F., M. D., associate professor of physical education, teachers college, Columbia University, New York.

Winslow, C.-E. A., Dr., Ph., professor of public health, Yale University School of Medicine, New Haven, Conn.

Zinsser, Hans, M. D., professor of bacteriology, Medical School of Columbia University, New York.

STATE AND CITY HEALTH OFFICERS.

Black, John T., commissioner of health, Hartford, Conn.

Biggs, Hermann M., M. D., commissioner of health, State of New York, Albany, N. Y.

Crumbine, S. J., M. D., secretary and executive officer, Kansas State Board of Health, Topeka, Kans.

Dalton, Charles F., M. D., secretary, Vermont State Board of Health, Burlington, Vt.

Durrett, J. J., professor of public health, University of Tennessee, Memphis, Tenn.

Chesley, A. J., M. D., executive officer, State Board of Health, St. Paul. Minn.

Fronczak, Francis E., M. D., health commissioner, Buffalo, N. Y.

Goldsbury, Paul W., M. D., secretary, Rural Health and Medical Service, Deerfield, Mass.

Kelley, Eugene R., M. D., State Commissioner of Public Health, Boston, Mass.

Hayne, James A., M. D., State health officer, Columbia, S. C.

Levy, E. C., M. D., director of public welfare, Richmond, Va.

McCormack, A. T., M. D., State health officer, Louisville, Ky.

Nicoll, Matthias, jr., M. D., deputy commissioner of health, Albany, N. Y.

Olin, Richard M., M. D., commissioner of health, Lansing, Mich.

Snively, Harry H.. M. D., director of health, Columbus, Ohio.

Vaughan, Henry F., M. D., commissioner of health, Detroit, Mich.

Wadsworth, Augustus, M. D., division of laboratories, State Department of Health, Albany, N. Y.

Welch, S. W., M. D., State health commissioner, Alabama State Department of Health.

Williams, Ennion G., M. D., State health commissioner, Richmond, Va.

REPRESENTATIVES OF SEMIPUBLIC AND PRIVATE HEALTH ORGANIZATIONS.

Armstrong, D. B., M. D., executive officer, National Health Council.

Brown, Walter H., M. D., director, child health demonstration, National Child Health Council, Mansfield, Ohio.

Dublin, Louis I., Ph. D., statistician, Metropolitan Life Insurance Co., New York City.

Ferrell, John A., M. D., Dr. P. H., director for the United States, International Health Board of Rockefeller Foundation, New York City.

Frankel, Lee K., Ph. D., third vice president, Metropolitan Life Insurance Co., New York City.

Geier, Otto P., M. D., director employees' service department, Cincinnati Milling Machine Co., Cincinnati, Ohio.

Green, Frederick R., M. D., secretary council of health and public instruction, American Medical Association.

Hatfield, Charles J., M. D., managing director, National Tuberculosis Association, 370 Seventh Avenue, New York City.

Kellogg, Vernon, Ph. D., permanent secretary, National Research Council, 1701 Massachusetts Avenue, Washington, D. C.

Snow, William F., M. D., general director, American Social Hygiene Association, lecturer, school of hygiene and public health, Johns Hopkins University.

Calver, Homer N., director, health service, American Red Cross, national headquarters, Washington, D. C.

Vaughan, Victor C., M. D., chairman, division of medical sciences, National Research Council.

Vincent, George E., Ph. D., LL.D., president, Rockefeller Foundation, New York City.

Work, Hubert, M. D., president, American Medical Association; Postmaster General Washington, D. C.

Yerkes, Robert M., M. D., chairman, research information service, National Research Council, 1701 Massachusetts Avenue, Washington, D. C.

REPRESENTATIVES OF VARIOUS FEDERAL AGENCIES.

Butler, Charles S. J., M. D., commanding officer, Naval Medical School.

Davis, William H., M. D., chief statistician, vital statistics, Bureau of the Census.

Bell, W. B., division of economic investigations, Bureau of Biological Survey, 1358 B Street SW., Washington, D. C.

Howard, L. O., M. D., Ph. D., chief, Bureau of Entomology, Department of Agriculture.

Ireland, M. W., Major General, United States Army, Washington, D. C.

Jones, R. F., M. D., Lieutenant Commander, in charge division of preventive medicine, Bureau of Medicine and Surgery, Navy Department.

Parker, Valeria H., M. D., executive secretary, Interdepartmental Social Hygiene Board.

Rude, Anna E., M. D., director, division of hygiene, Children's Bureau.

Siler, J. F., M. D., Lieutenant Colonel, Medical Corps, United States Army.

Small, Willard S., Ph. D., specialist in school hygiene, Bureau of Education, Washington, D. C.

Stitt, E. R., M. D., Surgeon General, United States Navy.

White, William A., M. D., superintendent, St. Elizabeths Hospital.

White, William Charles, M. D., chairman, consultants on hospitals under Secretary of the Treasury; chairman medical research committee, National Tuberculosis Association, 370 Seventh Avenue, New York city.

REPRESENTATIVES OF THE UNITED STATES PUBLIC HEALTH SERVICE.

Carter, H. R., M. D., Assistant Surgeon General at Large.

Clark, Taliaferro, M. D., surgeon, in charge of child hygiene.

Cumming, Hugh S., M. D., Surgeon General.

Draper, W. F., surgeon, rural sanitation, United States Public Health Service, Richmond, Va.

Frost, W. H., M. D., surgeon, professor of epidemiology Johns Hopkins University School of Medicine.

Goldberger, Joseph, M. D., surgeon, in charge of pellagra investigations, Division of Scientific Research.

Kerr, J. W., M. D., Assistant Surgeon General, in charge of Division Personnel and Accounts.

Lavinder, C. H., M. D., Assistant Surgeon General, in charge of Division of Hospitals and Relief.

Lumsden, L. L., M. D., surgeon, in charge of Rural Sanitation Studies.

McCoy, G. W., M. D., surgeon, Director, Hygienic Laboratory.

McLaughlin, Allan J., M. D., Assistant Surgeon General, in charge of Division of Domestic Quarantine.

Pierce, C. C., M. D., Assistant Surgeon General, in charge of Division of Venereal Diseases.

Schereschewsky, J. T., M. D., Assistant Surgeon General, in charge of Division of Scientific Research.

Stiles, Charles W., M. D., professor and chief of the Division of Zoology, Hygienic Laboratory, Washington, D. C.

Stimson, A. M., M. D., surgeon, assistant director, Hygienic Laboratory.

Sydenstricker, Edgar, statistician, in charge of Statistical Research, Division of Scientific Research.

Thompson, L. R., M. D., surgeon, in charge of section of industrial hygiene, Division of Scientific Research.

ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
5 CENTS PER COPY
▽

TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 125
SEPTEMBER, 1922

TRANSACTIONS OF THE THIRD ANNUAL CONFERENCE OF MALARIA FIELD WORKERS

HELD AT HOT SPRINGS, ARKANSAS
NOVEMBER 15–17, 1921

Prepared by Direction of
THE SURGEON GENERAL

WASHINGTON
GOVERNMENT PRINTING OFFICE
1922

ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
20 CENTS PER COPY

LIST OF SPEAKERS.

Opening remarks: Page.

Mr. J. A. Le Prince 2

The use of arsenic as a larvicide for Anopheline larvæ:

Dr. M. A. Barber (paper) 5
Mr. J. A. Le Prince 12
Mr. W. H. W. Komp 12
Mr. E. B. Johnson 12
Dr. M. A. Barber 13
Mr. F. R. Shaw 13
Mr. G. Parker 14
Dr. T. H. D. Griffitts 14
Mr. W. G. Stromquist 15
Dr. W. E. Deeks 15
Dr. C. P. Coogle 15
Dr. H. R. Carter 17
Mr. H. W. Van Hovenberg 18

Effect of drainage districts on the control of malaria in the Mississippi Delta:

Mr. L. L. Hidinger (paper) 23
Mr. W. G. Stromquist 35
Mr. G. Parker 36
Mr. J. G. Foster 36
Mr. F. R. Shaw 37
Mr. L. M. Fisher 37
Mr. J. L. Clarke 38
Mr. W. H. W. Komp 40
Mr. E. B. Johnson 40
Dr. C. H. Kibbey 40
Dr. H. R. Carter 41
Mr. L. L. Hidinger 42

Seasonal incidence of malaria with special reference to transmission:

Dr. C. C. Bass (paper) 43
Dr. M. A. Barber 46
Dr. C. C. Bass 46
Dr. H. R. Carter 47
Dr. E. F. Bowers 47
Dr. W. E. Deeks 47

The use of dynamite and T. N. T. in blasting ditches:

Mr. J. L. Clarke (paper) 49
Mr. W. B. Alford 56
Mr. H. N. Old 59
Dr. C. P. Coogle 59
Mr. J. L. Clarke 59
Mr. A. W. Fuchs 61

A plan for increasing efficiency in malaria-control projects:

Mr. W. H. W. Komp (paper) 63
Mr. J. A. Le Prince 66

A plan for increasing efficiency in malaria-control projects—Continued. Page.

Mr. F. R. Shaw 66
Mr. G. Parker 67
Mr. L. C. Frank 67
Mr. H. W. Van Hovenberg 68
Mr. L. M. Fisher 68
Mr. W. H. W. Komp 68

Effective press propaganda:

Mr. E. B. Johnson (paper) 69
Mr. F. R. Shaw 72
Mr. L. C. Frank 73
Mr. W. G. Stromquist 73
Mr. W. H. W. Komp 74
Dr. T. H. D. Griffitts 75

Educational work, exhibits for schools:

Mr. E. H. Magoon (paper) 77

Methods of malaria control used in Talladega County, Ala.:

Dr. J. H. Hill (paper) 83
Mr. E. B. Johnson 86
Dr. C. P. Coogle 87
Mr. J. A. Le Prince 88

Malaria control on the Central of Georgia Railway:

Mr. H. N. Old (paper) 89
Mr. J. A. Le Prince 93
Dr. C. Barrow 93
Dr. L. D. Fricks 98
Dr. H. R. Carter 99
Mr. H. W. Van Hovenberg 101
Mr. H. N. Old 101
Mr. P. H. Smith 102

Methods of approaching doctors, municipal authorities, and the general public relative to malaria investigations:

Dr. C. P. Coogle (paper) 103
Mr. E. B. Johnson 106
Dr. C. H. Kibbey 106
Dr. E. F. Bowers 107
Dr. C. P. Coogle 108

Paper on screening:

Mr. L. G. Beers (paper) 108
Mr. J. A. Le Prince 108
Dr. T. H. D. Griffitts 108
Mr. G. Parker 109
Dr. H. R. Carter 109
Mr. W. G. Stromquist 110

Mosquito control by means of small fish and methods employed for their multiplication:

Mr. H. C. Woodfall (paper) 111
Mr. S. F. Hildebrand 115

Legal phases of malaria-control work in Arkansas cities:

Mr. R. P. Hamby (paper) 123
Mr. T. R. Lathrope 123
Mr. F. P. Gilbert 125
Dr. H. R. Carter 126

Tide-gate operations at Savannah, Ga.: Page.

Mr. H. N. Old (paper) 127

Economic losses from malaria:

Mr. A. W. Fuchs (paper) 129
Dr. M. F. Boyd 140
Mr. H. N. Old 140
Dr. L. D. Fricks 140
Dr. E. F. Bowers 141
Dr. H. R. Carter 142
Mr. A. W. Fuchs 142

Malaria-control campaign at Greenwood, Miss.:

Mr. J. L. Clarke (paper) 143

Mosquito control at Memphis:

Mr. W. G. Stromquist 150

Control of malaria in Texas by reduction of *Anopheles quadrimaculatus* only:

Mr. G. Parker (paper) 153

Removal of vegetation by burning:

Mr. W. Ropes 154
Mr. F. R. Shaw 156
Mr. J. A. Le Prince 157
Mr. W. Ropes 157
Mr. W. H. W. Komp 157
Dr. E. F. Bowers 157

Third day, general discussions:

Mr. J. A. Le Prince 157
Mr. W. H. W. Komp 158
Mr. W. Ropes 158
Dr. L. D. Fricks 158
Dr. T. H. D. Griffitts 160
Mr. H. A. Kroeze 161
Mr. J. G. Foster 162
Dr. H. R. Carter 162
Mr. W. G. Stromquist 162
Mr. F. R. Shaw 163
Mr. E. H. Magoon 164
Mr. B. Mayne 164
Dr. C. P. Coogle 164
Mr. P. H. Smith 165
Mr. S. F. Hildebrand 165
Mr. G. Parker 165
Mr. E. B. Johnson 166
Mr. H. N. Old 168
Mr. J. L. Clarke 168
Mr. A. W. Fuchs 169

Exhibits:

Mr. W. Ropes 169
Mr. E. B. Johnson 169
Mr. H. W. Van Hovenberg 169
Dr. E. F. Bowers 170
Mr. W. G. Stromquist 170
Dr. H. R. Carter 171
Mr. E. H. Magoon 171
Mr. A. W. Fuchs 172

Exhibits—Continued.

Page.
Mr. F. R. Shaw 172
Mr. J. L. Clarke 173
Mr. G. Parker 173
Mr. W. H. W. Komp 174

Larvicides:

Mr. W. Ropes 174
Mr. F. R. Shaw 174
Mr. E. H. Magoon 175
Mr. H. N. Old 175
Mr. J. G. Foster 175
Mr. H. W. Van Hovenberg 176
Mr. H. A. Kroeze 178
Mr. J. L. Clarke 178

Culex:

Mr. H. A. Kroeze 179
Mr. W. Ropes 180
Mr. E. H. Magoon 180
Dr. C. P. Coogle 180
Mr. T. R. Lathrope 181
Mr. H. W. Van Hovenberg 181
Mr. A. W. Fuchs 182
Mr. J. L. Clarke 182
Mr. W. H. W. Komp 182
Mr. E. B. Johnson 182
Dr. T. H. D. Griffitts 182
Mr. J. A. Le Prince 183
Mr. W. G. Stromquist 183
Dr. E. F. Bowers 185
Mr. J. G. Foster 185
Mr. B. Mayne 186
Mr. G. Parker 186

International Health Board budgets:

Mr. F. R. Shaw 187
Mr. G. Parker 187
Mr. L. G. Lenert 188
Dr. H. R. Carter 188
Mr. W. G. Stromquist 189

Oil:

Mr. J. G. Foster 189
Mr. W. G. Stromquist 189
Mr. E. B. Johnson 190
Mr. W. H. W. Komp 190
Mr. W. Ropes 190
Dr. H. R. Carter 191
Dr. C. P. Coogle 191
Mr. P. H. Smith 191

Artesian wells:

Mr. J. L. Clarke 192
Mr. H. A. Kroeze 192
Mr. E. H. Magoon 193
Mr. J. G. Foster 193

ILLUSTRATIONS.

Page.
FIG. 1. Drainage ditch overgrown with willows and other tree growths. Heavy line shows approximate channel section 42
2. Another view of the same ditch after clearing of growth. Heavy line shows approximate channel section 42
3. Growth of water hyacinth in a drainage ditch. This growth often covers the entire water surface of a ditch in a thick mat which seriously retards the flow of water 42
4. Profile showing proper placing of dynamite 57
5. Blackboard outline in which labels on the exhibits are explained and distinguishing features indicated 42
6. General science class—dipping larvæ from a stream and capturing Anopheles imagoes resting on the banks 78
7. An exhibit which may be recommended for use in a high school. The material displayed may all be carried in the 13-inch traveling bag marked No. 1
8. Sketch map of Dialville, Tex 155

THIRD ANNUAL CONFERENCE OF MALARIA FIELD WORKERS.

TRANSACTIONS.

The third annual conference of malaria field workers was held at Hot Springs, Ark., November 15–17, 1921. The following persons were present at the conference:

Asst. Surg. Gen. H. R. Carter.

Surg. L. D. Fricks.

Special Expert M. A. Barber.

Senior Sanitary Engineer J. A. Le Prince.

Associate Sanitary Engineers L. M. Fisher, A. W. Fuchs.

Asst. Surg. K. F. Maxcy.

Epidemiologist T. H. D. Griffitts.

Associate Sanitarian Bruce Mayne.

Acting Asst. Surg. C. P. Coogle.

Assistant Sanitary Engineers J. C. Carter, J. G. Foster, E. H. Gage, W. H. W. Komp, L. G. Lenert, H. N. Old, F. R. Shaw.

Scientific Assistant W. A. Davis.

Sanitary Engineers I. H. B., J. L. Clarke, E. M. Craig, jr., F. P. Gilbert, H. A. Johnson, E. H. Magoon, George Parker, N. H. Rector, William Ropes.

State Health Officers Oscar Dowling, C. W. Garrison, J. A. Hayne, W. S. Leathers, S. W. Welch, E. G. Williams.

Members of State Health Departments M. Z. Bair, E. B. Johnson, H. A. Kroeze, T. R. Lathrope, J. S. Mitchener.

Members of City Health Departments P. H. Smith, W. G. Stromquist.

Visitors W. B. Alford, L. G. Beers, C. C. Bass, E. F. Bowers, Craig Barrow, E. R. Cotham, W. B. Crowgey, A. S. J. Collins, S. W. Douglas, W. E. Deeks, L. C. Frank, J. C. Geiger, L. L. Hidinger, Preston Hunt, T. L. Hoffman, G. H. Jones, W. E. Jones, D. J. Jenkins, C. H. Kibby, D. C. Lee, J. G. Phipps, H. H. Stage, R. L. Saxon, R. B. Sullivan, J. H. Thomas, H. W. Van Hovenberg, G. A. Warren.

THIRD ANNUAL ANTIMALARIA CONFERENCE.

The meeting was called to order at 9 a. m., November 15, 1921, at the Woodmen of the World Hall, Hot Springs, Ark., by Senior Sanitary Engineer J. A. Le Prince.

OPENING REMARKS OF J. A. LE PRINCE.

We all realize the importance of investigations that will lead to the estabishing of new, better, and more economical methods of malaria elimination, Anopheles elimination, and mosquito control.

Progress along those lines has been made since our last meeting, and we are to hear at this conference how we can use a certain arsenical compound without injurious results and accomplish a satisfactory Anopheles control under conditions that formerly required such expenditure of funds and energy as to be discouraging. About 17 years ago Sir Roland Ross stated he hoped the day would come when we should have such an economical larvacide available.

We shall hear of—

(1) Reported success in economical removal of vegetation for which there was apparently no former method of procedure.

(2) Successful county-wide antimalaria operations in Alabama.

(3) Towns now employing "all time" trained malaria-control inspector-foremen to serve the municipality throughout the year because of the public appreciation of the value of their services in mosquito elimination.

(4) Towns assuming the responsibility of making Anopheles-control operations a permanent item of their annual budget, on a par with road and street maintenance.

(5) Important investigations to determine the possibility of Anopheles control by attacking exclusively the *Anopheles quadrimaculatus* and ignoring presence of *Anopheles punctipennis*, experimental drainage operations by means of explosives, and the latest developments of Anopheles elimination by means of fish control.

It would be unfair to refer to our success only. It is thought advisable to refer to matters which we have paid insufficient attention to and where improvement is necessary.

The ultimate aim of our field work and of our annual conferences should be the practical elimination of malaria from the United States, and that day is not as far away as many people imagine.

I think you all agree that a large part of the success of our project depends on the personal interest and initiative of the local foreman or inspection on each project. While the selection of the right man to fit this position is an important step toward success, yet it is only one step. It must be made the business of the field director or supervising sanitary engineer to transmit sufficient enthusiasm, intense interest, and interesting practical knowledge concerning the proposed work, so that the foreman will become and remain deeply interested in keeping a close check on all field operations, and take pride in his reports of measuring the successful status of results accomplished. Success can not be obtained unless we make it our business to see that our representative is as interested in his local problem as we are in our larger ones. All of our foremen must be taught how to check up on their own work and to measure its efficiency. Their interest along that line is an indicator of their efficiency.

In some instances it appears as if more satisfactory results might be obtained if the State health department made a serious effort to make it more widely known to the public that Anopheles elimination and relative mosquito nuisance freedom are two distinct classes of work.

Before starting a campaign in a community at least 90 per cent of its people should know what it is proposed to do and why. They are paying for the work and are entitled to this information.

We should feel honored, as we have with us at this meeting our leader in applied malaria control, Dr. H. R. Carter, representatives of southern cities doing work similar to ours, and representatives of large and well-known commercial interests which have proved to their own satisfaction that malaria control is a necessary and decidedly satisfactory investment.

Your attention is invited to the antimalaria exhibit, located at the Eastman Hotel.

The first paper on our program is "Use of arsenic in the destruction of Anopheline larvæ," by Dr. M. A. Barber.

THE USE OF ARSENIC AS A LARVICIDE FOR ANOPHELINE LARVÆ.

Special Expert M. A. Barber, Technical Assistant T. B. Hayne.[1]

Roubaud[2] has successfully used trioxymethylene or paraformaldehyde in poisoning Anopheline larvæ. This powder, undiluted or mixed with some inert dust, is simply strewn on the surface of the water where it is eaten by the larvœ. The poison acts on the nervous system of the insect, causing paralysis, and when eaten in sufficient quantity death results within a few minutes. It is said to be harmless to any animal, aquatic or otherwise, except the surface-feeding Anopheline larvæ. A sublethel dose is said by the author to confer on the Anopheline larvæ a degree of resistance to a subsequent dose.

We have confirmed the work of Roubaud to the extent that we have found trioxymethylene very toxic to Anopheline larvæ, both in laboratory and in field tests. It seemed worth while, however, to extend this line of investigation and to search for some substance cheaper and more poisonous to the larvæ than trioxymethylene, since the use of a fine powder, which acts through ingestion, would seem to be a very promising measure against Anopheline larvæ. These larvæ lie at the surface of the water and in feeding turn the head halfway around into such a position that the feeding brushes carry to the mouth any particles lying on the surface tension layer of the water. The larvæ swallow all floating substances and are quite indifferent as to whether these are food or poison—just so that the particles are small enough to enter the mouth easily. No bait of any kind is required to make these larvæ eat anything that is offered them.

Moreover, poisons in the form of a fine powder are very conveniently distributed. The surface tension layer of the water affords a convenient support for the powder, whether it be heavier than water or not, and the floating particles are further distributed by currents of air after they reach the water. Again, the insect in feeding draws to it particles lying at some distance from the head.

---

[1] Some of the later experiments in this work were done by Assistant Sanitary Engineer W. H. W. Komp.

[2] Roubaud, E., Compt. Rend. des Seances de l'Acad. des Sci., vol. 171, 1920, p. 51. Ibid., vol. 170, 1920, p. 1521.

After a trial of a considerable number of substances, we found compounds containing arsenic most promising, and of these Paris green has proved most efficient.

Laboratory experiments.—A laboratory test was devised by which the toxicity of a substance for Anopheline larvæ could be quantitatively measured. The powder to be tested was strewn lightly upon the surface of water in a Petri or other convenient dish, a larva was pipetted into this dish, and the time when the particles of powder began to be swept into the mouth was observed carefully under a hand lens. At the close of any desired feeding period, the feeding time being reckoned by the number of seconds during which particles were entering the mouth, the larva was pipetted out, washed in two waters in order to free it from any adhering poison, and then deposited in a second dish for subsequent observation. A number of larvæ were thus fed on the substance to be tested, and the length of time of survival and the proportion surviving after a given dose gave a rough estimate of the toxicity of the substance. Highly soluble substances were mixed with pollen or some other inert powder before testing. In case we desired to ascertain the time of survival after the maximum dose merely, a number of larvæ were placed in a dish, the poison strewn over them, and the time of survival of each larva noted. In most of our experiments the size of the larvæ and the temperature of the water were also noted.

A large series of laboratory experiments were carried out, in which a number of substances were compared, including several of the commoner arsenic-containing compounds. One or two protocols, given in brief, will illustrate the method and results of these experiments.

Ten Anopheline larvæ, the size of which varied from one-quarter to full-grown, were fed on trioxymethylene, and nine similar larvæ on Paris green, the dosage varying from "minimum"—that is, the ingestion, or apparent ingestion, of one or two particles—to a dose represented by three seconds' feeding. Of the larvæ fed on trioxymethylene none was dead 16 hours after feeding, while 4 of the 9 fed on Paris green were dead within 3 hours, and a fifth in less than 5 hours. Since one could not always be sure that a larva taking the "minimum" dose had really swallowed the poison, the experiment was repeated, allowing doses of 3 to 5 seconds. Of 12 fed on Paris green 11 died within periods varying from 85 to 103 minutes, while of 12 fed on similar doses of trioxymethylene 6 survived at least 4½ hours. The 6 of this lot which died, however, showed a shorter average time of survival than that of the 11 which succumbed to Paris green; 62.5 minutes was the average survival time of the trioxymethylene and 90.7 of the Paris green.

In another series, trioxymethylene, lead arsenate, and Paris green were compared, the dosage of the first two poisons varying from 4 to 15 seconds and that of the Paris green from 2 to 10 seconds. All of the larvæ fed on the trioxymethylene, 4 in number, died in less than 1 hour; of the Paris green series 9 out of 10 died within less than 2 hours and the tenth after about 7 hours; of the lead arsenate series practically all survived until the next day or later.

As is illustrated by the two protocols given above, the Paris green did not always cause a more rapid death than trioxymethylene, but the proportion surviving after a very small dose was always less in the case of Paris green than with any other poison tested, a point of considerable weight in favor of Paris green as a practical larvicide, since it is not always possible to give the larger doses when treating a pond or stream.

The extreme sensitiveness of Anopheline larvæ to Paris green was impressed on us by several laboratory accidents, in which the very slight amount of powder accidentally thrown into the air during the process of mixing or measuring the poison caused a high mortality among larvæ kept in the stock pans on the same table.

Paris green freed from the water-soluble portion by long treatment with water was still poisonous for larvæ, so it is probable that certain of the digestive fluids of the larvæ act as solvents for the poison.

Lead arsenate and arsenic trioxide—"white arsenic"—were both much inferior to Paris green as larvicides for Anopheline larvæ, and powdered arsenopyrite seemed to be wholly inert. We have tested the calcium arsenate in common use for dusting cotton plants, both in the laboratory and in the field, and find it decidedly less effective than Paris green. We would not recommend its use in place of Paris green except in case of emergency. In one experiment we successfully treated about 1,200 square feet of Myriophyllum-covered water with about half a pound of calcium arsenate mixed with sand. In other field experiments where considerably less quantities were used the results were very unsatisfactory.

Field experiments.—In field experiments a sketch was usually made of the breeding place to be treated, and before treatment a number of dips were made with a definite-sized dipper over different parts of this area, the location of the dips being approximately indicated on the sketch. In recording the Anophelines present before and after treatment, the number of the pupæ and the number and size of the larvæ were recorded, the sizes being usually designated as full, three-fourths, one-half, one-fourth, and small. The reexamination of the breeding place was usually done at least three and one-half hours after treatment and often on the next day.

A protocol of a field experiment will illustrate the method and results: The breeding place was a pond covered with grass, the blades of which projected an inch or two above the surface of the water. The temperature of the water at the surface was 35.2° C. and at a depth of 10 inches, 26° C. Approximately 4,000 square feet were treated with 10 cubic centimeters of Paris green mixed with about a quart of fine sand. The dust was thrown into the air by hand, the main distribution being effected by the wind. The sum of 31 dips over the whole area before treatment was as follows: Pupæ, 1; full-grown larvæ, 12; three-fourths-grown larvæ, 3; half-grown larvæ, 7; one-fourth-grown larvæ, 16; small larvæ, 124; total, 163. About 24 hours after treatment the sum of 31 dips over the same area was as follows: Pupæ, 2; full-grown larvæ, 0; three-fourths-grown, 1; half-grown, 0; one-fourth-grown, 3; small, 6; total, 12. In this experiment the amount of poison used was very small, and the grass formed a barrier to its spread, but there was an almost complete destruction of the larger larvæ and of over 95 per cent of the smaller ones. Other experiments have been done where the numbers of larvæ were much larger and the percentage destroyed much higher, and in some experiments no survivors could be found.

The following kinds of breeding places have been successfully treated: Impounded water with larvæ protected by floating wood; cold water in a ditch immediately below a spring, the larvæ protected by thick water cress; grass-covered ponds and those covered by Myriophyllum; ground below a spring and covered with a thin layer of water; wet pasture with breeding in cow tracks; an old ditch the water of which was covered with duckweed and partly protected by overhanging weeds; various small pools without any particular covering. In small pools a few pinches of the diluted Paris green sufficed to destroy the larvæ. The species of Anopheline apparently makes no difference as regards their resistance to this poison.

Quantity and method of use of Paris green.—Paris green in anti-Anopheline work should be diluted with a large proportion of inert dust. Only very small doses are necessary to poision larvæ, and the dilution enables one to spread a relatively small quantity of the poison over a large surface. Further, any risk of poisoning the operator or the water treated is minimized by the use of the diluting dust. As a diluent we have successfully used fine sand, rotten wood dust, and road dust. Road dust, preferably mixed with some fine clay, seems to be as effective as any. The addition of weight in the form of some coarser sand is helpful in enabling one to direct the dispersal of the lighter dust. Some of the diluting dust sinks on contact with the water, but most of the arsenic is left on the surface. Flowers of sulphur has not proved a suitable diluting dust, possibly because so large a proportion of it remains floating that it is ingested with the Paris green, which latter is then too much diluted. A dilution of about 1 part of the poison to 100 of the inert dust seems to be a favorable mixture.

The quantity of Paris green to be used must depend somewhat on the character of the breeding place. Where there is much high grass, reeds, and the like, one would use somewhat greater quantities of the poison than where the surface of the water is clear or covered by low-surface vegetation only. Since the poison is relatively inexpensive, and the danger of poisoning the water of the breeding place small, quantities somewhat larger than those given in the protocol would seem to be advisable, possibly about 10 c. c. (approximately 12 grams, 0.43 ounce avoirdupois, 0.6 cubic inch, or two level teaspoonfuls) to 1,000 square feet.

A slowly settling cloud of dust carried along by a light wind is apparently the best agent for the distribution of the dust, and the main thing is to start this cloud in the right place and direction. A single cloud may destroy larvæ over a wide area and at a considerable distance from the operator. We have tried certain mechanical means for distributing the dust, such as the dust guns used in dusting arsenic on cotton plants, but thus far we have succeeded best by simply throwing the dust into the air by hand. The cloud can thus be formed high or low, to the right or to the left, depending on the force and direction of the wind. The pole and bag method, sometimes used for dusting plants, has been found useful in treating a breeding place at the bottom of a deep ditch.

Time of day for use of the powder.—The best results are to be expected on a sunny day, when the powder is spread after the sun is well up and the dew has disappeared from any vegetation covering the breeding place.

Frequency of treatment of a breeding place must depend largely on the temperature of the water. In a recent experiment Anopheline larvæ were thoroughly destroyed over a given area. The place was kept under observation from day to day and frequent collections of larvæ made. Eleven days after treatment, fully grown larvæ and a few pupæ were found. In this breeding place, then, it would have been necessary to repeat the treatment within 10 days. The weather was warm and the temperature of the water very high, and it is probable that in this pond the growth of the larvæ (larvæ of *A. quadrimaculatus*) was nearly at its maximum rate.

Cost.—Paris green was recently quoted at 22 cents per pound, f. o. b. New York City, packed in 300-pound barrels. Small quantities may be purchased in drug stores for $1 per pound. At 25 cents per pound the amount sufficient for at least 1,000 square feet, or 10 c. c., would cost about seven-tenths of a cent. The calcium arsenate in common use for dusting cotton plants may be purchased for about 15 to 20 cents per pound. The use of a powder instead of a liquid should greatly lower the cost of transportation. Usually a dust suitable for dilution can be found in the neighborhood of the breeding place, so that one has to transport only a pound or so of Paris green for the treatment of a large area.

Danger of poisoning the operator or the water treated.—In our experiments we have used no precautions other than to stand to the windward of the dust cloud—the place where one would naturally stand in distributing the dust—and we have experienced no harmful results whatever. However, even with the small quantities used in larvacide work, it is well to remember that one is working with a poison, and that some precautions should be taken, at least, until the matter is further investigated. It is probably sufficient to keep to the windward of the dust clouds and to avoid inhaling the dust so far as possible. In case a great deal of exposure is necessary, one should use some precaution to keep any large amount of Paris green from entering the clothing or accumulating anywhere on the skin.

As regards the danger of poisoning the water treated, it should be emphasized that only a minute quantity of Paris green is dusted over a very large surface and of that compound only a very small fraction is water soluble. We have never observed any effect of the poison on Culicine larvæ or on any other aquatic insect or animal, however delicate, other than on the surface-feeding Anopheline larvæ. In particular, we have never observed any indication of harm to top-feeding minnows or to any other natural enemy of larvæ. The danger to domestic animals through drinking treated water seems very remote. In order to meet any objections on the part of the owner of a breeding place, one might arrange to have the stock removed from the breeding place for a day or so, but the owner will hardly insist on this precaution when it is explained to him that the powder is the same as that commonly used against insects and that only a very small quantity of it is to be used on a large body of water.

In sum, the possible advantages of arsenic dust used against Anopheline larvæ are its cheapness, portability, ease of distribution by means of the wind, and the possibility of using it over areas difficult of treatment by methods now in use. The chief disadvantage is that its use is limited to Anopheline larvæ—ova and pupæ of all kinds and Culicine larvæ are apparently unaffected. It is believed, however, that this method will have a place in antimalaria work, especially in places not easily drained and so covered by vegetation or other obstacles as to render them inaccessible to natural enemies of larvæ or to other methods of treatment.

The danger to persons engaged in distributing arsenic-containing dusts as larvicides would seem to be mainly through the possibility of inhalation of the poison or its absorption through the skin, rather than through ingestion. In our search for information regarding the possible harm to men or domestic animals engaged in distributing arsenical dusts as insecticides, we sent letters of inquiry to 17 United States or State Agricultural Experiment Stations in the cotton or tobacco-growing States in the hope that information might be obtained from those who have had much practical experience with these dusts and their possible harmful effects. In some States these arsenical dusts, calcium arsenate in particular, have been used by the ton in combating boll weevil. Of the 16 stations replying to our inquiry, 14 of the correspondents had had experience in the use of arsenical dusts. Of these 14, about half had knowledge of some injury to man or domestic animals through the use of these arsenical dusts. The lesions reported were chiefly of the acute type and of a minor degree, such as sores on exposed parts of the body, irritation of the bronchial tubes, and sometimes intestinal disorders—lesions which usually healed promptly. Some more serious cases of chronic poisoning were reported to us by Mr. B. R. Coad, in charge of the Delta Laboratory, United States Bureau of Entomology, at Tallulah, La., who kindly wrote us a full description of these cases. The cases were of the cumulative type of poisoning, and occurred exclusively among persons who had worked with the dusts in close quarters for several years. They occurred as the result of exposure to calcium arsenate as well as to other kinds of arsenic dusts. "The chronic types of poisoning are practically always accompanied by some dermatic disorder, the nature of which varies widely with the individual, and is somewhat recurrent. Furthermore, in extreme cases we find neuritis and occasionally some fairly pronounced heart symptoms. It has proved a very obnoxious ailment, and, furthermore, a very stubborn one. Apparently it is brought about by a saturation of the system with arsenic, and the victim is nearly always hypersensitive to arsenic exposure. In the case of constant exposure the mucous membranes of the nose and throat reach such a condition that they are exceedingly sensitive to mechanical irritation by any form of dust, and a slight exposure to dust brings on an attack which very closely resembles hay fever."

It is to be remembered that these chronic cases followed a long and intimate exposure to arsenic dusts. Mr. Coad was of the opinion that the amount of exposure incident to the anti-Anopheline work we have described would probably not lead to any particular danger. It is significant that so little trouble is reported by experiment station workers and by other persons who have used arsenic dusts extensively for some years. Possibly their immunity has been due in part to the fact that they use principally the little water-soluble calcium arsenate, and that cotton-plant dusting extends over a comparatively short period each year. However, in anti-Anopheline work where such small quantities of highly diluted Paris green are used, and where the work is wholly out of doors, simple precautions should suffice to protect the user, nor would a health officer anticipate any strenuous objections from the people of a community to the use of a substance so commonly employed as an insecticide.

DISCUSSION.

Mr. LE PRINCE. I had the pleasure of seeing one of the experimental tests, and I believe, if I had taken photographs of parts of that body of water and presented them to this audience, you would have judged that it was solid land rather than vegetation floating on the surface of the water that you were looking at. There was excellent Anopheles control of that pond. We desire to have this matter discussed by a man who has been fortunate enough to be with Doctor Barber, and I will call on Mr. Komp.

Mr. KOMP. Mr. Chairman, I have two photographs of an area that was treated, just outside of Montgomery, Ala., which I will pass around. It had the same type of vegetation that Mr. Le Prince has spoken about, in this case mostly Hydrochloa, the silver-leaf grass. If I had known about the use of Paris green three months previously—that is, while my work was going on in Mississippi—I would never have used a drop of oil, and would have been able to do the same work at about one-sixth the cost. We may hope for an improvement in one point. Arsenic will not kill Culex larvæ. This is due to the difference in the feeding habits of Anopheles and Culex larvæ, the Anopheles being surface feeders. We hope something equally effective against Culex may be worked out. The main advantage of arsenic is that we can control Anopheles breeding in difficult situations, in seepage outcrops, and in places where we have no fish control, or where the fish are prevented by dense vegetation from getting at the larvæ. The great effectiveness and low cost of Paris green render it a most valuable means of control.

Mr. LE PRINCE. The subject is open for discussion.

Mr. JOHNSON. I have had the pleasure of seeing some of these experiments both in Talladega and at Montgomery. I have never seen such destruction of larvæ; that stuff just went onto the water and the larvæ died then and there. There is one question I want to ask Doctor Barber: How long does a single application last? That is an important point. With oil, we have to oil once a week; if this Paris green will last over a week, it has a great advantage over oil.

Mr. LE PRINCE. I think it would be preferable to answer the questions as asked, if you would prefer it that way, Doctor Barber.

Doctor BARBER. I will answer two questions at once. First, the chief disadvantage of arsenic as a larvicide is that it attacks only Anopheline larvæ; eggs, pupæ, and Culicines in all stages are left untouched. Second, the larvicide should be applied as often as once in 10 days during the warm season, when development is going on at its maximum rate. Anopheline eggs are probably unharmed by the larvicide, and they soon hatch out and produce a new brood.

Arsenic was applied to a certain pond in Mitchell County, Ga., and the most complete destruction of larvæ resulted. We went over the treated area repeatedly and could not find a single larva. After about two days small larvæ began to appear, some of which reached the pupal stage in about 10 days. The temperature of the water reached about 102° F. in early afternoon and was 76° F. at 5 o'clock in the morning, so it is probable that conditions for rapid development were favorable. The species of Anopheles was *A. quadrimaculatus.*

Mr. SHAW. I am particularly interested in this because I think we will have a very fine opportunity to use this method next season. A dam across Cane River below Natchitoches causes a lake the edges of which are heavily grown with aquatic plant life and algæ. I would like to know how this heavy growth will affect the use of arsenic? Will it require a heavier treatment?

Doctor BARBER. We tried it in a number of places in which plants were growing very thickly over the surface of the water. I should use rather more arsenic where vegetation is abundant.

Mr. SHAW. From your experimental work, are you able to recommend a method of distributing it or carrying it to the location when the work is done on a large scale? The lake edge to be treated is about 2 miles in extent.

Doctor BARBER. I should say that one person could carry by hand enough arsenic for the treatment of 2 miles of lake margin. If one has enough dust for diluting the arsenic at the locality to be treated he need not carry that.

Mr. SHAW. That is all right in some cases, but in others one can't get road dust at a convenient distance.

Doctor BARBER. Very fine sand can be used to dilute the arsenic dust.

Mr. SHAW. How about sawdust?

Doctor BARBER. Something that is easily carried by the wind, like road dust, is the best.

Mr. SHAW. I understood you to say that it had no effect on Gambusia.

Doctor BARBER. We went over every place we treated with arsenic and found no effect on anything except on the surface-feeding Anopheles larvæ. There is hardly any other water animal that feeds on the surface as the Anopheles larvæ do, and the only danger one would anticipate to Gambusia would be through their feeding on poisoned larvæ. That danger, in our experience, does not seem to be serious.

Mr. SHAW. What is your opinion of the cost of using arsenic as compared to clearing of vegetation? In this case, the clearing of vegetation for a distance of 5 or 6 feet from the bank, and a length of 2 miles on each side of the lake, would give the Gambusia free access and excellent control would be effected.

Doctor BARBER. I should certainly give the arsenic a trial. The cost of the Paris green needed for about 1,000 square feet of breeding surface is approximately seven-tenths of a cent.

Mr. LE PRINCE. I believe in the coming year in many of our projects our costs are going to be materially reduced by using this larvacide, and now is the time for you gentlemen to ask questions.

Mr. PARKER. I would like to ask Doctor Barber if, in carrying on these experiments, he has confined his efforts to still water, or if he has used the slowly moving streams, in which we may expect some Anopheles breeding, and what the results were on these streams.

Doctor BARBER. We used the arsenic very successfully in a ditch in which there was a slow current. Mr. Komp treated this ditch, using the pole and bag method sometimes employed for dusting plants. It was an *A. quadrimaculatus* breeding place, but one where one would ordinarily expect to find *A. punctipennis*. In some experiments we placed the dust on the surface of water and depended on the current of the stream to carry it to the larvæ at the margin. These attempts were partially successful, but it is apparently best to let the air carry the dust rather than to depend on water currents.

Mr. LE PRINCE. In regard to the matter of dust travel, the next time a Ford passes you when you are walking on a dusty road notice the way in which the dust cloud from the Ford gets to a considerable distance from the road.

Doctor GRIFFITTS. I have seen the time when I would have welcomed Doctor Barber with a little bottle of Paris green, like an angel from the skies, to use on vegetation-covered ponds that couldn't be controlled reasonably economically in any way that we could then find. I would like to ask Doctor Barber what effect summer showers have immediately after casting this dust on the surface, and also on rather large ponds what effect wind or breeze will have in carrying it from one part of the pond to another. The limited observation, that I have had suggested that larvæ are not killed in less than an hour's time.

Doctor BARBER. We made some very careful experiments in the laboratory as regards the time of survival of larvæ after poisoning. We fed arsenic to larvæ and then segregated them and observed how long they survived. After a light dose they sometimes lived two or three hours; after a heavy dose they lived 30 minutes to 1 hour. As regards summer showers, such would not prevent the action of the arsenic dust if they came two hours or more after the application of the dust. Wind should help the distribution of the dust, since it usually carries floating particles to the places where the larvæ have lodged.

Mr. LE PRINCE. I want to be sure that you realize the importance of this subject. Some of you gentlemen here, particularly the engineers, may be going to the Tropics some day to take up antimalaria work, and, if you do, you will find interference to your control work by vegetation tenfold what it is up here and you can see the advantage of this method of control that is being tried out.

Mr. STROMQUIST. Mr. Chairman, as regards the effect of the wind carrying the dust to one side of a large pond, the places where this method will be more effective, as compared with other methods, is where there is much vegetation, and in such places the wind would have the minimum effect in carrying it from one part of the pond to the other after you get it on. I should not think the effect of the wind in reducing the efficiency of this method would be very great.

Doctor DEEKS. In applying his method Doctor Barber referred to the effects of the arsenic on the operator. It is well known that some people are more susceptible to arsenical poison than others, and I would like to suggest that the operator would be amply protected if he wore a gauze mask over his mouth and nostrils and used rubber gloves.

Mr. LE PRINCE. We desire to hear from Doctor Coogle.

Doctor COOGLE. It was my good fortune to assist Doctor Barber with a few of his experiments in Talladega County, Ala. In a pasture about 10 acres in size, 15 cows had been grazing. There were a number of small springs oozing out of the ground over an area of about 2 acres. In this area the ground was soft and there were hundreds of hoofprints, each of which was partly filled with water containing many larvæ of both Culicine and Anopheline types. Doctor Barber made very close observations of the conditions. The arsenic dust was then applied. In less than two hours the final observations were made; great care was exercised; a very minute inspection was made; no living Anopheline larvæ were found. Certainly the arsenic dust fell on quite a lot of the grass; the cows continued to graze in the pasture. It is believed that they grazed over this area. There were no ill effects to the cows whatever.

Another experiment was carried out on an inlet of impounded water on the Coosa River. Several tons of driftwood had been washed into this little inlet. It was pretty well matted together, most of it floating. The ends of some of the logs were on the bank sufficiently to anchor the entire mass in this inlet. Small bits of bark and other floatage were sufficient to protect the larvæ from the fish and other enemies; very close observations by Doctor Barber were given to me to record. I noted the Anopheline larvæ would average about two or three to the dip. The powder was then dusted over the area, about 40 by 90 feet. In about 70 minutes we checked the area. I think only two live larvæ were found, and they probably would not have survived. I can mention another experiment. There is a little spring coming out of the fill in the railroad near Talladega Springs. From the spring down a distance of about 60 or 70 feet was a very heavy growth of water cress; the water was hidden from view; the average number of Anopheline larvæ was about 12 per dip. The arsenic powder was dusted over this area; in about four hours the regular routine observations were made; no live larvæ were found. The powder works down between the vegetation; the larvæ soon gets it and that ends its life. As Doctor Barber says, it worked like magic. It is certainly very effective in destroying Anopheline larvæ.

Mr. JOHNSON. Mr. Chairman, there are two or three points I would like to bring up. In the first place, the one Doctor Coogle mentions about water cress. The people at Talladega Springs saw you men there, and a few days later, when I visited the town, these places had been ditched.

Another thing, we made some experiments there. In two of those water-cress areas we tried kreso dip No. 1. Before applying we got, I think, 267 wigglers, and one hour after applying about 10 cents' worth of kreso dip No. 1 to a surface of about 100 square feet, we found in the same number of dips about 9 or 10 live wrigglers. Most of these were sick and would probably have died in a short time. A great advantage was that it killed the Culex as well as the Anopheles.

After Doctor Barber left Talladega County, we used Paris green several times during heavy winds; if the Paris green was blown off, it certainly killed the wigglers first.

This method is of great value where the vegetation is so thick oil will not work; in such places Paris green does work.

Mr. SHAW. What is the effect of the arsenic on plant life, such as rice? Would it have any effect on the growth of rice? Could arsenic be used effectively in rice fields? I have made some observations in rice fields and find that breeding occurs in only certain locations, particularly in the ditches around rice fields. Apparently there is no effective control for a large field, but sometimes a rather small field prevents control around a town.

Doctor **Barber**. These poisons have often been used for the destruction of insect plant pests. I should say that the amounts used for larvicidal work would be absolutely innocuous to plants.

Mr. **Le Prince**. Doctor Carter, who is with us, has seen many places where it would have been economically impractical to control the Anopheles situation, and to-day we think we have a means of handling it. We should like to have a few remarks from Doctor Carter.

Doctor **Carter**. Personally, of course, I am not familiar with the use of Paris green, but for a number of years we have been trying to find methods of treating Anopheles breeding places which could not be controlled by the fish. As to the use of coal oil, we well know it is hard to get anybody to carry coal oil on his back; also it isn't reliable in much vegetation or in pond breeding, when the surface is covered with drift and floatage in which the Anopheles lie.

Mr. **Le Prince**. We can handle that with sand soaked in coal oil. You can throw it where you can't spray.

Doctor **Carter**. In all work where the vegetation is above the water, if the vegetation above the surface of the water is profuse, to my mind the coal oil is useless, no matter how applied, unless applied in enormous quantities. There are two systems of oiling—one at regular intervals of time independently of breeding and one only where breeding is found after inspection. For the second, if we can have the inspector use his own oil or larvicide, we save the services of one or more men. This is not generally possible with oil. It may be so with arsenic over a large part of the area to be controlled. The amount of arsenic to be transported is so small that the inspectors, maybe with one man to help, can destroy the breeding places almost as fast as they can be found by him.

Mr. **Le Prince**. May I call on Doctor Barber to close the discussion.

Doctor **Barber**. In the first place, credit for this work should go to Roubaud, who did the pioneer work with trioxymethylene dust, as well as to the writers.

As regards the point brought out by Doctor Deeks—the possible effect of arsenic dust on the person distributing it—I wish to state that in an article on arsenic as a larvicide, which will soon appear, such possible effects will be discussed. It is true that certain precautions should be taken, but I should think very simple precautions would suffice, since one is working in the open and with very highly diluted dusts.

Mr. Stromquist. I make a motion that this conference go on record with a vote of thanks to Doctor Barber for the method which he has developed, and which from the standpoint of pond control is the most important development made recently in the control of mosquitoes.

(The motion was duly seconded and carried.)

Mr. Le Prince. We thank you, Doctor Barber.

Mr. Van Hovenberg. I have been asked by a number of the engineers and others present to ask the permission of the Chair to speak on a matter that is quite in line with the object of this meeting.

Mr. Le Prince. You have it.

Mr. Van Hovenberg. And, with your permission, I would like to say a word about the presence of Doctor Carter. We are all greatly honored by his presence at this time. We look on him as a father of the engineers in malaria-control work, and it seems to me that it is quite fitting that we should ask Doctor Carter to honor us again by taking a place in this conference as consulting adviser. Perhaps a better name might be chosen, but that seems appropriate to me. He has been the adviser to all of us, and we certainly wish him to continue in that capacity. And I would like to offer this suggestion as a motion at this time.

(The motion was duly seconded and carried.)

Mr. Le Prince. Doctor Carter, you are consulting adviser.

The author of the next paper, unfortunately, can not be with us this morning, and I am going to delay the reading of that paper.

We are very fortunate in having with us the medical director of the United Fruit Co. Doctor Deeks has had a very large experience in dealing with malaria and malarial problems, and at the present time probably has a larger field of malaria control than all the rest of us put together. His representatives are working in many parts of the Tropics and sub-Tropics. Now, the time may come when you gentlemen may be down there, and you will appreciate the opportunity of hearing remarks from Doctor Deeks.

I might also mention this fact, that in the work in Mexico last year I found quite a large number of engineers and geologists who were put in charge of field parties and large working forces—anywhere from half a dozen to 500 men or more—where there was no medical man present. The engineers had charge of the quinine work, which was forced upon them. They didn't know what the standard treatment was. They used an improvised treatment, the best they knew how, and I am going to ask Doctor Deeks to speak on the subject.

Doctor Deeks. When I first went to Ancon Hospital the routine method of treating malaria was (in addition to calomel and salts) to give 10 grains of quinine three times daily after meals, and this was continued until the patient felt well enough to leave the hospital, which was from one to three days after the temperature was normal. The result was that frequently the patients were returned to us with a relapse on the same day or a day or two afterwards.

We then insisted that the patients remain in the hospital until five days had passed without fever—meanwhile taking 30 grains of quinine daily in solution. This gave exceedingly gratifying results in the prevention of relapses, as it enabled the patient to increase his resistance. On a generous diet, and with the extra amount of quinine administered, a cure was frequently successful, particularly in the benign forms. Doctors Gorgas and Carter were so surprised with the results that the order was issued to the effect that the method of treatment be followed in all the hospitals and sick camps in the zone.

After following this method for three or four years, and finding that a few cases still relapsed, we increased the dosage to 15 grains three times daily during their hospital stay, and we found that our results were better still; and this continued to be the routine method until the canal work was finished. That is the routine method now followed in all our hospitals which we operate in the Tropics, and if we can persuade our patients to take 15 grains twice daily, on every Saturday and Sunday for 8 weeks following the hospital treatment, we feel that we can effect a cure in all cases unless they are suffering from some other debilitating constitutional disease which interferes with their normal resistance and which requires special treatment.

I am of the opinion. therefore, that the standard treatment recommended so strongly here will not meet our needs in plantation work in the Tropics, as it is practically impossible to influence our laborers outside hospital control to take the quinine daily, as recommended.

There is one more important point that I wish to bring to your attention. It is the class of cases that Mr. Le Prince referred to. In frontier work when no adequate sanitary measures can be taken in advance, and where engineers and other important officials have to do preliminary work where they are exposed to malarial infection, if we instruct them to take 15 grains of quinine in solution, say, every Wednesday and Saturday night, the chances of infection are greatly diminished, and if infected the work of curing them is greatty facilitated.

We carried on prophylactic work in one of our divisions in Cuba during the past season according to this method. Accompanying each dose in solution we gave one-half an ounce of rum, which was an added inducement to take the quinine, and the result was that we reduced our morbidity for malaria 75 per cent over that of another division in the immediate vicinity where the work was not done.

We strongly recommend the prophylactic measure when men know that they are going to be exposed to malarial infection.

Mr. Le Prince. Doctor Deeks, I know all of the engineers are particularly interested in the situation in the Tropics, and I am sure that one or two of the engineers may be glad to have the opportunity of asking a question or two.

Doctor Coogle. It was my understanding the size of the dose and the amount of quinine per week for prophylactic purposes would be the same as that necessary to disinfect a malaria case. I understand you recommend only 15 grains on Wednesdays and Sundays, or 30 grains a week.

Doctor Deeks. That is for prophylactic purposes.

Doctor Coogle. Thirty grains a week for disinfecting purposes also?

Doctor Deeks. That is for prophylactic purposes.

Doctor Coogle. For prophylactic purposes I have been using 70 grains per week—10 grains each night.

Doctor Deeks. Is that for curative purposes?

Doctor Coogle. That amount has been recommended for prophylactic purposes, too.

Doctor Carter. That is for sterilizing purposes or for immunizing purposes—where a man has no malaria and who is going where he is sure there is malaria. If he will flood the system twice a week with 15 grains, he should get no malaria. Fifteen grains might be sufficient, but I have always used it twice a week.

Doctor Coogle. As I understand, the standard quinine treatment can be recommended for curative purposes, disinfecting purposes, sterilizing purposes, and also prophylactic purposes; and for an adult the standard quinine treatment contains 70 grains per week.

Doctor Deeks. I think for curative purposes the standard treatment will not succeed in the Tropics. You may have different conditions here and a milder form of malaria than in the Tropics; but we found it didn't work in Ancon.

Doctor Coogle. Is that too much quinine to recommend for prophylactic purposes?

Doctor Deeks. It is more than is necessary; and why give so much if we can succeed with 30 grains a week?

Mr. Le Prince. Can an engineer start engineering operations, even on a small scale, if he does not take the measures you are taking now?

Doctor Deeks. We couldn't work in the Tropics at all unless we had an efficient hospital corps and a sanitary system, because the white men would become so infected they wouldn't stay with us. Under the conditions we have at present it is just as safe for the white men in the Tropics as in the North. They all take their families there and our mortality rate is less than it is in New York.

Mr. Le Prince. For those who are particularly interested, may I ask regarding the publication of the annual report of your company?

Doctor Deeks. We issue an annual report, and try to send it to those who are interested all over the country. I have a copy here, and if any of you are interested and will drop a line to the office I will be glad to furnish you with a copy.

Mr. Le Prince. Would you give the address?

Doctor Deeks. 17 Battery Place, New York City, United Fruit Co., General Manager, Medical Department.

Mr. Le Prince. We thank you, Doctor Deeks, for your kindness. We have seen for a number of years the necessity of major drainage operations, and some of us believe that long before the State health departments are able to cope as the State health officers wish to with our so-called big malaria problems of the South, they will be largely done away with through the drainage projects now being installed. We shall hear of these projects from the president of the Morgan Engineering Co., of Memphis. Mr. Hidinger.

EFFECT OF DRAINAGE DISTRICTS ON THE CONTROL OF MALARIA IN THE MISSISSIPPI DELTA.

L. L. Hidinger,

Member American Society of Civil Engineers, President Morgan Engineering Co., Memphis, Tenn.

Throughout the lower Mississippi Valley drainage of large bodies of land has been going on for many years until at the present time a considerable area of the swamp lands of the alluvial Mississippi Delta have been afforded agricultural drainage by means of artificial channels constructed by organized drainage districts. The southeast corner of Missouri, the eastern side of Arkansas, and the western part of Mississippi, known as the Yazoo-Mississippi Delta, all represent regions where drainage districts have carried out extensive improvements for agricultural drainage.

The work undertaken by such drainage districts is primarily for the purpose of providing drainage outlet channels into which farm and plantation ditches can be dug. Some farm drainage is received by the lands immediately adjacent to the new channels, but the main function of drainage districts throughout the South is to furnish the outlets. The smaller ditches which are needed to thoroughly drain the lands into the outlet ditches naturally follow as the country is opened up by agricultural development. However, before this is done the outlet canals reduce the size of the existing pools of water, and consequently the time which such pools hold water is considerably lessened because the smaller amount that remains is evaporated or soaks away in a shorter time.

An illustration of the removal of ponds of standing water by district canals is found in one of our drainage districts, just south of Memphis, in northern Mississippi. In one part of this district were a series of long parallel slashes or ponds which had always held water and furnished a breeding place for mosquitoes. One of the outlet ditches in the district was dug at right angles to the general direction of these ponds, and the result was that where frogs and water lilies previously flourished, the land is now perfectly dry and subject to cultivation, and offers no chance for mosquitoes to breed.

Although drainage-district canals are excavated to afford agricultural drainage, nevertheless, it must be recognized that such canals are an absolute necessity in the Delta country of the lower Mississippi Valley before the control of malaria by the reduction of breeding places for mosquitoes can take place. Up to this time the elimination of mosquitoes and eradication of malaria has been a side issue, a by-product, so to speak, but from now on it must be made one of the main issues by drainage district officials.

A majority of the drainage ditches are dug by floating dipper dredges. These machines, although very economical for removing earth, leave the bottom of the channel ordinarily a series of depressions and ridges which will hold water in times when the channel would otherwise be entirely dry. Such pools are usually below the grade line of the ditch necessary for furnishing drainage to the adjoining lands, and from the standpoint of agricultural drainage no harm is done. Such pools, however, furnish very convenient places for the breeding of mosquitoes. There is no practical way of draining out such pools except at great expense, and for purposes of malaria control we believe that they can best be handled by oiling, dusting with arsenic, or some other similar method.

MAINTENANCE.

It is the opinion of a great many persons engaged in antimalaria work that most drainage systems are carelessly planned and constructed from the malaria standpoint. We do not agree that such is the case in the flat Delta lands of the Mississippi Valley. It is our opinion that work looking to full control of malaria is a second step and that it logically falls into the maintenance stage of a drainage district. However, maintenance work must be done differently and more intensively for malaria control than for agricultural purposes. The drainage engineer is faced with maintenance problems as soon as the canals of a district have been excavated, and he usually handles these problems from the viewpoint of good agricultural drainage. The sanitary engineer engaged on malaria control desires to remove or render harmless the possible mosquito harbors, and in so doing he is confronted with much the same problems of maintenance as the drainage engineer. Since the two are so closely related, we believe it is advisable to discuss at some length the causes of deterioration of drainage ditches and the methods and costs of maintaining them.

The maintenance of drainage canals from the standpoint of agricultural drainage falls naturally into three classes:

First. Removal of bars and slides.

Second. Removal of tree growth, drift, logs, etc.

Third. Removal of water weeds.

Each of these subjects will be considered under separate heads.

Removal of bars and slides.—Bars and slides are the result of several causes. A decrease in the velocity of the water in the ditch may cause the deposition of silt carried by the water at higher velocities. The most frequent cause, however, is from material deposited by the cutting back of local drains or side ditches entering through openings in the spoil banks or sides of a canal. Other causes are by material washing down from the slopes of the ditch itself and by slides in the banks and, in some cases, by slides in the spoil banks. Fences and floodgates, which are sometimes built across drainage channels, offer obstructions which quite frequently cause the formation of bars above them.

The maintenance problem resolves itself into some method of either removing the bars and slides or minimizing their effects on the ditches. In the usual case the bar will cause a pool of water to collect. Such pools, when the slides are small, may not be at all serious from the standpoint of land drainage, but from the malaria standpoint they are very serious. When the bars are larger they may offer serious obstruction to the flow of water in the ditch and may materially reduce its capacity for carrying water. The removal of such bars presents what is perhaps the most difficult problem encountered by a drainage engineer in looking after the maintenance of large drainage systems. The bars are usually scattered throughout the length of a large mileage of ditches and frequently are not readily accessible. The volume of earth in each bar is ordinarily not great in any one place, but the cost of removal is considerable and the results obtained are not always certain. Bars can be removed either by hand methods, with teams and scrapers, with ditching plows, or by the use of dynamite.

Which method is best is not yet well established. Blasting bars with dynamite is usually the most convenient method, because two men can carry on the work and the dynamite outfit can be moved about from place to place with less difficulty than team or hand equipment. Dynamiting has the disadvantage in that the explosion of the charges in the bottom of the ditch tends to disturb the stability of the surrounding material and the ditch banks, a fact which may cause further slides. However, largely because of its ease of operation, we have used dynamite extensively in removing small bars.

In connection with maintaining several drainage districts in Washington County, Miss., the Morgan Engineering Co. has kept accurate cost data. In one case where sandy material had accumulated in the bottom of the ditch, raising the grade for a mile or more to an extent that threatened the drainage of lands farther upstream, a narrow ditch was dynamited through the middle. The work on this ditch was done in 1917, when the cost of labor and material was considerably less than it is now, the cost at that time being approximately 10 cents per linear foot of ditch. Under present conditions the same work would undoubtedly cost upward of 20 cents per linear foot.

During the same season and in the same districts numerous small silt bars were removed from a number of ditches. The total length of bars dynamited slightly exceeded 1,500 feet, the individual length of the bars ranging from 16 to 108 feet. No attempt was made to remove the entire bar from the ditch but only to secure a low-water channel of sufficient depth and width to make certain that effective low-water drainage was secured for all tributary lands. As a rule, the ditch secured was 5 or 6 feet wide on the bottom, with side slopes somewhat flatter than 1 to 1. The cost per linear foot of bar removed for this work was about 40 cents.

During the summer of 1920, in the Bogue Phalia drainage district, in Washington County, bars and slides were removed from a total length of 84 miles of ditches, the average cost being about $67 per mile. In the Riverside drainage district, in the same county, similar work was carried out over 67 miles at an average cost per mile of $43. These costs refer to blasting such low-water channels as was necessary in order to remove bars that would seriously retard low-water flow and provide mosquito-breeding areas.

On some experimental maintenance work on Jacob Swamp Canal, in North Carolina, carried on in 1917 by the Bureau of Public Roads, United States Department of Agriculture, a low-water channel 6 feet wide with an average cut of 0.34 foot was excavated in the bottom of the canal along the center line. The work was done by men with shovels and the excavated material was thrown against the side of the ditch at the foot of the bank. Low-water channels were opened up through sand bars by the same methods. Over a length of 11,000 feet the cost of the work in 1917 was $2.12 per 100 feet or $112 per mile. In 1919, when maintenance work was again resumed after the war, no further work was done on opening up low-water channels; the Government engineers decided that "it is doubtful if it is necessary to do work of this kind" on canals such as that of Jacob Swamp. No doubt this is true from the standpoint of agricultural drainage, but it is far from true when considering the eradication of the malaria mosquito.

Removal of tree growth.—Another factor in the maintenance of drainage ditches is the growth of tree sprouts which spring up soon after the excavation of an artificial drainage channel and which are a serious menace to the efficiency of a drainage system unless regularly removed. The Morgan Engineering Co. has planned and carried out maintenance work on several hundred miles of drainage channels in several large drainage districts for a number of years and has determined closely the cost of removing tree growth under varying conditions.

In drainage district No. 9, of Mississippi County, Ark., we have maintained a system of 300 miles of drainage channels for the past seven years. In 1915 and 1916 the work of removing willows, cottonwoods, and other tree growth, together with drift, fences, tree tops, logs, and small stumps, was done by contract at prices ranging from $27.50 to $57.50 per mile. In 1917 the work was done by force account and the costs ranged from as low as $6 or $7 per mile on laterals to $65 per mile on some of the large outlet channels. In the season of 1918 a total of 190 miles of ditches was cleared at an average cost of about $51 per mile, the lateral ditches averaging $45 and the outlet channels $58. In 1919 costs ran considerably higher, owing to the abnormal labor conditions. The average cost of 47 miles of work was about $96 per mile, but much of this work was on large outlet ditches. In 1920 the costs for 33 miles of lateral outlet ditches averaged $120 per mile, and for 28 miles of larger outlet ditches, $184 per mile. These costs are very high, because the work was done when labor was costing over $5 per day, including subsistence, and when it also was very inefficient. In 1921 the conditions had changed and labor was plentiful and men were willing to give a day's work for a day's pay. The result is reflected in the greatly reduced costs. The prices averaged $47.50 per mile for 38 miles of lateral ditches and $34 for 50 miles of larger outlet ditches. These costs per mile for the larger outlet ditches were lower, because these same ditches had been cleared in 1920, whereas all of the lateral ditches had not been.

In the Bogue Phalia drainage district, in Washington County, Miss., in 1917, 51 miles of ditches were cleared by force account methods at an average cost of $26 per mile, and 22 miles were cleared by contract at an average cost slightly less than $15 per mile. In 1920, 24 miles of ditches were cleared in the same district at an average cost of $125 per mile. About two-thirds of this was very heavy growth in ditches where no work had been done for several seasons. In a neighboring district, 74 miles of ditches were cleared for $37 a mile, the lesser cost being due to lighter growth.

In the Little River drainage district, in southeast Missouri, costs for maintenance work in removing tree growth in 1920 averaged $104 per mile for 270 miles of ditches. In 1921 costs for 72 miles of work completed up to October 1 were about $75 per mile. All this work was done on ditches that had been dug from three to five years and on which no maintenance work had been done.

In the Inter-River drainage district, in Butler County, Mo., 16 miles of ditches were cleared by contract this season for $25 per mile. These ditches had passed through one growing season.

Removal of Weed Growth.—Weed growth is the third disturbing element in the life of drainage ditches which reduces their efficiency and tends to hold up the level of the water. In the Little River drainage district we have encountered a weed growth in some of the ditches which is particularly objectionable and which proved to be a considerable problem. The weeds are of the smartweed family, hollow jointed and very tough. They grow along the bottom of the ditch for a distance of about 5 to 15 feet, then turn up vertically and grow to a height of about 3 feet above the ordinary water level. Due to the weeds growing along the bottom a considerable distance before turning up out of the water, they form a compact mat about a foot thick. The following methods for removing the growth were tried: First, plowing them out with a Martin plow ditcher; second, dragging a heavy chain along the ditch by means of a team on each bank; third, sawing off the weeds with a saw made by twisting barbed wire into a cable; fourth, sawing with a patent weed saw; and fifth, pulling the weeds out by hand. The most successful method was found to be the last one enumerated; that is, for men to get into the ditch and remove the weeds, root and all. It was found that the thick bed of weeds would roll up like a mattress, the roots pulling loose as they rolled up. After as much of this mat had been rolled up as could be handled, it was cut loose and pushed up the slope of the ditch to within reach of men on the berm, who then placed the roll of weeds on the back edge of the berm. A total of 16 miles was cleaned of weed growth at an average cost of $71 per mile, labor being paid $2 and foreman $3 per day.

In the report on experimental maintenance work on Jacob Swamp Canal previously referred to, the common cat-tail is stated to have been found growing abundantly. "Stretches of 100 to 200 feet in extent were solid with this plant, taller than a man. It is estimated that at places the number of cat-tail plants ran as high as 10,000 to 15,000 to the hundred feet." These cat-tails were generally pulled by hand. The cat-tails have a long root extending horizontally and were not easy to remove. The conclusion drawn by the Government engineer from this experimental work is that the best results would be obtained by removing the plants when they have just about reached their maximum growth but before they have begun to seed or the sap started down into the root system. In this way much of the life of the plant for starting a vigorous growth the following year is killed.

We have investigated and studied many different methods of removing weeds of various kinds, but so far have not found any mechanical equipment which is adapted to the work and which can operate at a cost to justify its use. There are a number of burners or gasoline torches such as are used by the railroads in burning the weeds along the track. No experiments with these have been made on drainage ditches because of the many difficulties which suggest themselves in connection with their use. However, if the question of maintenance came down to a combined drainage and malaria problem, these difficulties might be overcome and it might be more practical to use some such device as a burner or torch in order to get rid of the tree growth and weeds at the same operation. The combined purpose of the work might justify the cost whereas maintenance for either purpose alone would not make it economically possible.

As a result of our experience in clearing growth from drainage channels for agricultural purposes, we have adopted a policy of clearing the lateral ditches once every two years and the main outlet channels every year. The latter channels are cleared every year in order that the full capacity of these ditches shall at all times be available for carrying water, even though the annual cost of the clearing work is somewhat greater by so doing. We consider this to be sound practice for ditch maintenance work from an agricultural standpoint. However, when reviewed with the idea of malaria control in mind, this criterion must be modified. For thorough malaria control as applied to drainage ditches, all of the ditches should be cleared and worked on every year and possibly twice a year in some cases.

It is evident that maintenance for malaria control will be more costly than for agricultural drainage only because malaria maintenance must be much more intensive in order to remove or render harmless all of the possible small pools where mosquitoes might breed.

To undertake to drain out all of the pools in the large drainage channels so that they would not hold any standing water whatever would be very costly and would cost considerably more than to provide a low water channel sufficient for land drainage purposes. It is not possible to estimate closely what this cost would be, but in any event we feel sure that it would be higher than some other means of accomplishing the same results.

This brings us, then, to the problem of determining what is the most practical solution of maintaining drainage outlet channels so that they not only furnish first-class agricultural drainage and at the same time do not furnish actual or potential mosquito breeding places. We believe that the solution of the problem is for drainage districts to adopt comprehensive maintenance programs for the purpose of ridding the ditches of tree growth and objectionable weed growth, and opening up low-water channels through the bars and slides together with such patroling and oiling as may be necessary. Tree growth should be removed more often than would be necessary for agricultural drainage and not only the large water weeds should be removed but the weeds and grass growing along the sides of the channel and the edge of the water should be cut in order to permit oil to get back into the irregularities of the channel and into the small pools caused by seepage. Some bars should be removed where economical to do so and where it is not, the pools caused by the bars should be oiled. It has been suggested that small narrow ditches within the large ditches would eliminate the pools. This might solve the problem where the soil is firm and the fall sufficient, but actual demonstration has proven that it is not true in the area under consideration. In the flat lands of the lower Mississippi Delta, the streams are sluggish and we believe that oiling will prove to be the best and most economical way of preventing the breeding of mosquitoes in many of the drainage ditches.

The extra cost of maintenance work, including malaria control with agricultural drainage, is something which can only be estimated as no work of this kind has as yet been done. We have not had wide experience in the cost of malaria-control work ourselves, but, basing the cost on our general experience and on data furnished us by those who have had experience with work of that nature, and using the costs of maintenance for land drainage which we have available, we are able to approximate general costs for the work.

The following is our estimate of the annual costs of maintenance work per mile of average drainage channel:

For agricultural drainage:	
Clearing tree growth	$15–$35
Removing bars or opening up low-water channel	25– 50
Clearing weeds	5– 10
Total	45– 95
Additional for malaria control:	
Clearing tree growth	10– 15
Cutting weeds	5– 15
Oiling pools	5– 10
Total	20– 40

The cost figures used in this table represent annual costs for drainage channels of average size. For example, the cost of clearing growth from channels in drainage district No. 9, of Mississippi County, Ark., was approximately $50 per mile the past season, but this was for three-year growth. The annual cost on that basis is therefore only about $17 per mile. However, if cleared every year to keep down malaria, the yearly cost would be increased, although the cost per mile for the work done would be somewhat less.

The water-weed clearing cost, considering a district as a whole, is only a few dollars per mile. As a rule, only a very small part of any large drainage system would be affected by water-weed growth, and while the cost per mile for removal is high, when this cost is spread over a large number of miles of channels, the proportional cost per mile is only a few dollars. In connection with weed growth, the distinction between such large thick growths as are produced by water weeds, cat-tails, and water hyacinth and ordinary smaller weeds and grass along the sides of the channel should be borne in mind. The former may cost $70 a mile to remove, whereas the latter may be cut for from $5 to $10 a mile.

Ordinarily there is about 1 mile of large drainage outlet channel for each square mile of land. Considering this to be the case, the cost for the additional work necessary for malaria control, including oiling, would be from 3 to 6 cents per acre. This would be a small price to pay for freedom from malaria.

On this same square mile of land, if it be intensively cultivated, we would find at least one family of five to each 40 acres. The population would, therefore, be 80 people. Let us assume, further, that among these people 30 cases of malaria develop each year and one death occurs every five years. Then, using $50 as the average cost of a case of malaria, and $5,000 as the value of a life, the total annual loss on 1 square mile of land would be $2,500. This plainly shows that even though the cost of malaria-control work was many times what we have estimated it to be, the savings each year would still greatly exceed the cost.

An illustration of the actual savings that can be accomplished by malaria-control work is given by an experiment carried on by Doctor Fricks, of the United States Public Health Service, in Georgia. In July, 1919, Doctor Fricks took charge of an area of about 25 square miles of badly infected malaria country. Owing to the work being started late in the season, it was impractical to construct drainage canals, so immunization by the use of quinine was the only method used. Results were successful, and by comparison with the cost of malaria sickness on the same area the previous year and on adjacent areas the same year, it was estimated by the Government authorities that the controlled area was saved a loss of about $12 per acre of cultivated land.

The total cost for malaria control must include a further item for work around the houses and on the farm ditches. Some oiling must be done and the farm ditches must be kept opened up. It is difficult to estimate what the cost of this kind of work will be, as no accurate data has been collected bearing directly on rural communities. However, estimates from persons with experience in similar work indicate that the cost of this class of work would be materially less than the cost of malarial control in the drainage district ditches.

In undertaking maintenance work for malaria control, oiling and weed cutting would not be necessary except where agricultural development had advanced to the point to justify it. It has been our observation that agricultural communities usually radiate out from various centers and do not often spring up singly in isolated spots, so that in starting malaria-control work in large drainage districts the work should begin in the well-cultivated areas and should extend to such a zone around each area as would be necessary to protect the area from mosquitoes.

FINANCING MALARIAL-CONTROL WORK.

Let us now consider the matter of financing such a program.

Funds for carrying on maintenance work in drainage districts are provided in most States by the levying of a general maintenance tax on the lands within the districts, this tax being authorized by the laws under which such districts are created and operate. The general drainage law of Arkansas provides that "the district shall not cease to exist upon the completion of the general drainage system, but shall continue to exist for the purpose of preserving the same, of keeping the ditches clear from obstruction, and of extending, widening, or deepening the ditches from time to time as it may be found advantageous to the district. To this end the commissioners may, from time to time, apply to the county court for the levying of additional taxes." Other State laws have similar provisions.

Practically all drainage laws specifically require that before a district be organized it must be shown to the satisfaction of the court that it will be economically feasible and conducive to the public health and welfare. Such being the case, we think there is no doubt that ordinary maintenance funds can be used for the purpose of eradicating the malaria mosquito in and along the drainage canals. However, it is doubtful whether such maintenance funds could be used for the work necessary in the fields and around the houses. It might become necessary to secure funds for this purpose from some other source.

EFFECT OF DRAINAGE DISTRICTS ON MALARIA.

Passing on to another phase of our subject, let us consider the effects of drainage district improvements, even without maintenance, from the malaria standpoint on health conditions in the districts. Where large areas of land have been drained the general health of the community has undoubtedly been greatly improved. Washington and Coahoma Counties, Miss., offer a concrete illustration of this fact. Mississippi County, Ark., and also southeast Missouri are other illustrations of this same fact that have come under our observation and where there is no question that conditions have been improved.

Statements have been made that drainage improvements sometimes increase malaria, but in all of our experience we have not come in contact with any place where this has been true. Although it is true that pools do form in the ditches and serve as malaria-breeding places, the area of such pools is so small in comparison with the areas of breeding places that have been drained and removed by the ditches that they are almost negligible. These pools along the ditches are also very small in comparison with the many pools which are not drained out into the ditches except in highly developed areas.

In general, it may be said that there is no doubt that the drainage of considerable areas of land by drainage districts has improved the health of these communities both directly and as a result of the development and prosperity which has followed the undertaking. We do not believe that any surveys have been made to determine the actual figures for decreases in malaria which has taken place in these drainage districts. Some surveys as to the results of malaria control have been made, but these have been made in places where special work has been done and have not covered any large areas such as are embraced within the large drainage districts of the lower Mississippi Valley. There is a fertile field for investigation to determine the actual figures on the decrease in malaria in some of the large drained areas. One area that we would suggest is the eastern part of Mississippi County, Ark., well back of the Mississippi River Levee, beyond the influence of the old bayous, sloughs, and chutes along the river. This part of the county has been drained for several years, and has undergone a period of extensive agricultural development, so that a study of the malaria conditions in this area compared with those in an undrained area would undoubtedly show what reduction in malaria there has been as a result of large-scale drainage operations.

In this same area the malaria-control measures for drainage ditches which we have suggested could well be undertaken as a start on work of this kind. The people in this community are broader minded, and we believe would cooperate in such a movement. Mississippi County has stood foremost in drainage development and has been an object lesson for other parts of the South in that regard so that it would be fitting that malaria-control work in large drainage districts should be initiated there also.

Other important areas in the Mississippi Delta which offer opportunities for malaria investigation and control work are the southeast corner of Missouri; Crittenden County, Ark.; Washington, Bolivar, and parts of Coahoma Counties, Miss.

A successful malaria-control campaign would serve as an example to surrounding drainage districts and to drainage districts all over the South. It is our opinion that if, along with the necessary maintenance for land-drainage purposes, a start can be made on carrying out a program of oiling, weed cutting, and other malaria-control work, the results will demonstrate so clearly and conclusively that malaria can be eradicated by such measures that there will follow an extension of the work throughout all the areas in the South where large drainage districts have constructed hundreds of miles of ditches and that eventually the entire country will be emancipated from the bonds of malaria.

But if this is to be the case, the work undertaken and the results obtained must be given wide publicity, particularly throughout the malaria belt of the South. In order that the most good may come from any work that may be undertaken, the people throughout the malarial States must be told about the work going on elsewhere so that new communities will take up the good work. Persistent publicity to inform the outside world of the measures taken and the results achieved from malaria-control work is equally as important, in our opinion, as the actual work itself.

SUMMARY.

1. Large drainage districts primarily provide drainage for agricultural purposes, but in the flatlands of the lower Mississippi Valley the drainage channels dug by these districts are an absolute necessity before malaria control can be accomplished, because natural outlets are inadequate.

2. Many pools and excess surface waters are drained away by the new drainage channels and the number of breeding places for mosquitoes is thus reduced in size and number. The agricultural development which follows the construction of the drainage ditches still further lessens the mosquito lairs, because the low swales and depressions are drained out and put into cultivation.

3. Maintenance of the drainage channels is of importance both from the standpoint of agricultural drainage and malaria eradication. Whereas satisfactory agricultural drainage requires that some canals be cleaned only every two or three seasons, malaria control will require work to be done at least once every year and usually several times.

4. Maintaining ditches for both agricultural drainage and malaria control means carrying out such work as may be required for good land drainage, and in addition, in well-developed areas, clearing the ditches more intensively and more often, cutting the weeds closely, removing some bars, and oiling the pools which it is not

practicable to drain. To do this extra-work for malaria control will add from $20 to $40 per mile to the cost of the maintenance work. This, however, amounts to only a few cents an acre on the land benefited and the economic saving will greatly exceed the cost of the work.

5. The money for malaria control in drainage district channels can be made available from the maintenance tax provided in most State drainage laws.

6. General health conditions have been greatly improved whereever drainage districts have constructed new channels. No statistics have been collected showing the actual benefits from large drainage districts in reducing malaria, and it is suggested that a survey for this purpose be made in some such area as the eastern part of Mississippi County, Ark. In the same area the maintenance program we have outlined for malaria control could well have its beginning.

7. The agricultural development which follows drainage improvements means more money for better health conditions. In the well-developed areas of the South, where drainage has taken place, it is economically feasible to entirely eradicate malaria by proper control work.

8. Any work that is done on a selected area should be given wide publicity in order that the work may spread to other parts of the South and eventually bring about complete freedom from malaria throughout the lower Mississippi Valley.

DISCUSSION.

Mr. STROMQUIST. Mr. Hidinger stated that what has been said about the increased prevalence of malaria following the establishment of drainage districts has not been true in their drainage districts. I think that this may be largely due to the thorough work and proper provision for maintenance which is insisted upon.

A mistake which seems to be quite common among drainage engineers is that they do not provide for maintenance, as their main idea is to get the drainage district established. The malaria-control men are possibly more interested in the maintenance. When we come in the major drainage operations are completed. It would be of mutual advantage, or at least to the advantage of the residents of the drainage district who must bear the cost of malaria as well as the drainage, if we could all work together. If the drainage engineers have some knowledge of what the sanitary engineers are trying to accomplish, they could plan their work so that the malaria control probably would be greatly simplified.

In this connection I wish to relate an incident to show one method of eliminating borrow pits along the railroads. Mr. William L.

Johnson, of Memphis, a dealer in farm and timber lands, has been engaged in buying rights of way for one of the principal railroads. Several years ago, before anything was known about malaria control, he was asked to buy some additional rights of way to make room for more sidetracks, the railroad already owning a right of way. He agreed to do this on the condition that the railroad company would agree to make continuous ditches so as to drain all borrow pits, stating that he knew most of the men that he would have to buy from and did not want to ruin their land for them. The railroad officials agreed to do this and Mr. Johnson would tell the landowner that the railroad company would not only leave no borrow pits but would make a continuous ditch, which would be to his advantage, as it would provide drainage for his land and that he was really getting paid for having a drainage ditch made for him. As a result he bought land for about $50 per acre for which the railroad expected to pay about $300 per acre, and both the landowners and the railroad company were well pleased with the bargain.

Mr. PARKER. Inasmuch as this subject has come up in regard to drainage projects in connection with malaria control, I think it is a most opportune time to say that I believe the field workers in malaria control are going to give a great deal of attention to what is commonly called "man-made malaria," and the construction engineers of railroads, the highway engineers, the drainage engineers, are all going to be asked to cooperate, and our cooperation with them is going to serve to do away with a lot of "man-made malaria" which costs the community a great deal of money to take care of. It is an obstacle that is put in our way which should not, under any conditions, exist, and it is something that we must remove in order to get malaria control at reasonable cost. I know of some instances where borrow pits have been made so deep that to drain one of them would have cost more than the expense of an entire town campaign; to have filled them would have cost equally as much. So the time, I think, is opportune to mention the fact that "man-made malaria" is one of the problems that we should center on next season.

Mr. LE PRINCE. I am going to call on one member of this association who in connection with malaria work has been busy interesting the farmers in the formation of drainage districts and who has obtained results. The work of formation of drainage districts and of getting the farmers interested in the formation of drainage districts is very closely related to our work. I wish to call on Mr. Foster.

Mr. FOSTER. I am afraid that the chairman has done me too much credit in that remark. I don't think that I can add very much to the able discussion of the matter by Mr. Hidinger.

Mr. SHAW. The point that impressed me in Mr. Hidinger's paper was the matter of outlet. Outlets have concerned me particularly.

During the work at Lake Charles our great difficulty was the lack of outlets. The fall averaged 1 foot in a mile, and after working a mile out of the town, we found that we did not have outlets. After a two years' lapse or discontinuance, the work has been instituted again. When the drainage district now under way is completed, it will bring large canals up to our work and give us the outlet we need. The district is outside the town, but it will provide the outlets.

Mr. LE PRINCE. I want to ask you whether the mosquito work had any influence on the formation of that drainage district?

Mr. SHAW. I think not, because it was voted in an outside district. During this season a great many people living in the outlying districts said to my foreman and to me: "It certainly is fine work. Why don't you extend it to such and such a place?" Not doubt, it brought to their attention the benefits derived from drainage, but probably the main factor in forming the district was the need of outlets for rice drainage.

Mr. FISHER. I would like to say in connection with that same thought that we tried to collect some information in regard to drainage districts that have been put through in South Carolina to find out whether the antimosquito feature had anything at all to do with it. We found it hadn't so far. It was entirely an agricultural undertaking.

We are hoping now to try to work along the lines that our friend indicated a bit ago; that is, to try to influence the creation of drainage projects.

There is one large project in our State where malaria prevails more seriously than in any other part of the State, in which something like 64,000 acres are involved. The project practically fell through about two years ago because of lack of confidence in certain of the men who were supporting it. One or two of the strongest opponents were opposed to putting at the disposal of the drainage comissioners two or three hundred thousand dollars which would be required to put the work through. One of the leading promoters of the drainage district came voluntarily to Dr. Hayne and asked for the assistance of the State board of health to help put the project across on the ground that it would be of great benefit from a malaria standpoint. We have already approached some of the opponents—some of those who actively opposed the project—and asked them whether they thought that if the two ideas were combined—the health-improvement idea with the agricultural idea—the project would stand any chance of going through. The most vigorous opponent of the enterprise said that he thought it would, so we are hopeful at the present time of succeeding. We don't know just what can be accomplished, but we believe it can be made the basis for a great deal of work along those lines. Our plan, while it is not definitely formed, is to make a malaria survey in addition to that made by the Bureau of Agriculture. We are planning to go to each house to see what must be done to protect the people in the area there and to add that additional cost to the cost of the agricultural drainage work and get a bond issue to cover everything, and then have a kind of supervisory control to see that the malaria will not be increased but will be reduced.

Mr. CLARKE. I would like to talk about three things: The organization of drainage districts, the maintenance of drainage districts, and how engineers could help in the organization of drainage districts.

Most of the drainage districts near the towns where we controlled malaria are too small to be handled by a practicing engineer; the overhead cost in promoting these drainage districts will be prohibitive from his standpoint. Therefore it is our duty to interest ourselves in improving these outlets for the city. Not only agricultural benefits are involved, but the health of the town. Most drainage laws in their preamble use the health and welfare of the community as one of their prime factors, but after the preliminaries this point is dismissed and the benefits are assessed on a basis of agricultural benefits alone.

In the organization of these small drainage districts, near cities, the city council should pay a part of the cost, and to that end, it seems to me, we should get busy and call a conference of the landowners whose land will be benefited, form an agreement with them, then present that agreement to the city in connection with our control work. This materially reduces the cost of the work for the city, work that would be prohibitive for the city if not carried on by cooperation with adjacent landowners whose land is benefited.

In connection with the maintenance of drainage canals, Mr. Hidinger has told you that one of the most important part of maintenance of drainage canals is the removal of silt bars. Now, silt bars affect the effective flow of the canal and at the same time present breeding places for mosquitoes in this way: These big canals have a very slight grade, as you know, and at the same time that these canals are taking care of the big floods there is a stretch of dead area in there —that is, a dead area from the top of silt bar down to the bottom of the canal—that cuts off the flow of water, and then, as I have said, in the summer season these stretches of water form breeding places for mosquitoes.

Now, I would suggest that when these canals are constructed that an exceptionally deep hole be dug at lateral inlets to accommodate the silt that is washed in, and thereafter, in the maintenance of them, when it fills up and creates these stretches of water, you can resort to dynamite or other methods of creating these holes again, in this way preventing the general silting up of the canal from point to point. This work was done in a small way at Newport News. There we had a very steep grade coming into a marsh where the grades were very flat. It brought down sand and filled up the ditch. In the early spring, before the flood waters started, we blasted a deep hole right at this point, at the bottom of the hill, where the hill and marsh joined. This hole took care of the silting up of the stream for a long while afterwards. I think these potholes from point to point would reduce the mosquito breeding considerably as they would be scattered from point to point which would be better than having a high point and then a considerable body of water above that.

Now, as to the ways in which the engineers might help in the formation of drainage districts, I might cite a case in which I testified at Batesville, Miss., in the case of the Tallahatchie drainage district. This district embraces about 500,000 acres of land in the Mississippi-Yazoo Delta. The cost of this work was estimated to be about $7,000,000. At a preliminary hearing I was called upon to testify as to the effect drainage would have on the health of those living within the district. I got the total number of malaria cases and deaths from the health department and computed the economic loss. Malaria cases were figured at $30 per case and deaths at $5,000. The annual loss was $480,000 to that area within the district. In order to determine just what they would be justified in expending for permanent improvements to do away with that loss, I capitalized the annual loss at 6 per cent, and it amounted to $8,000,000. I took the engineers' figures on the annual maintenance cost and capitalized it. That amounted to $1,250,000. Deducting this from the $8,000,000 leaves $6,750,000 which might be spent in permanent improvements if we could reduce malaria entirely in that area, and that will be done eventually because of the improvement. Then we would be warranted in expending $6,000,000, which would balance the total cost of the canal. I could state the proposition in a good many ways. Some other minor factors enter also, but that gives an outline as to the working principles. I might say that these figures could not at that time be broken down by the attorney, and of course they tried to discount or discredit the testimony as largely as possible, but it showed its effect, I think, on the judge.

Now, it seems to me that all drainage plans and specifications should be submitted to the State health department before the construction is started. I am satisfied that that would be a suggestion worth while. In this same case at Batesville the question came up as to the breeding places created by a series of borrow pits along the levee—which it was proposed to build. It was proposed by the engineer to drain these borrow pits, but the attorneys didn't understand it. They stated that it would create additional breeding places, but I showed them that the State board of health was alive and wouldn't allow it.

Mr. Le Prince. The subject is open for further discussion.

Mr. Komp. I would like to ask Mr. Hidinger what is the best time in which to remove the growth of vegetation—spring, summer, fall, or winter?

Mr. Johnson. It seems foolish, after hearing about these big drainage districts, to talk about a small one, but we have one in Alabama of some thousand acres on property owned by one man. There was a stream wandering down through it in a very meandering course and several hundred acres of swamp. The owner was as skeptical about drainage as we were for we doubted whether there would be a dollar return for a dollar spent. However, we finally advised him to go ahead, and he did. He has dug a straight canal, some 10 feet wide and 4 feet deep, through the place, and numerous side ditches. I don't know how much malaria there has been in the vicinity, but I do know that in previous years there has been an average of two deaths from malaria a year. The project is only about two-thirds completed, but this year there has been no death from malaria and but one or two cases. That is one return. Then, again, before his project was completed the owner more than paid for the work by crops planted on reclaimed ground.

Dr. Kibbey. Mr. Chairman and gentlemen, I believe every sanitarian to be interested in drainage projects of every sort, whether they be carried out primarily for agricultural or other purposes.

These are the days of specialists. We have them in medicine. We have them in every branch of human activity. We need, it would seem, another specialist in public health—the salesman. We have something people need; it can be purchased; it is up to us to convince them that we have the thing they ought to buy.

Why would it not be possible, in considering drainage projects for agricultural purposes, to combine with this the health problem (malaria control), showing the economic advantages of increased land values, together with the further advantage of having at the same time a malaria-free population?

Why not combine or coordinate the efforts of the drainage engineer and those of the sanitary engineer; present the proposition on a purely economic basis and sell the community the thing we we have to offer?

Agricultural land is of little value except in the hands of those physically able to furnish the energy—man power—necessary for tilling the soil and for gathering and marketing the crops.

I don't believe you will find a community anywhere in the world with good roads who had not been first convinced that good roads were cheaper than poor transportation facilities.

I doubt if many organized communities can be found with adequate fire protection which did not first have a fire, or series of fires, against the cost of which might be balanced the cost of fire-protective equipment and maintenance.

There is an economic law which exacts payment for that which is needed, whether it is purchased or not.

That community needing agricultural drainage pays for agricultural drainage in decreased land and crop values, even though they do without drainage.

Likewise the community needing malaria control is apt to pay more in economic losses for the continued prevalence of malaria than its complete eradication would cost.

This must be to some extent demonstrable. Might not the salesman enter here, selling the drainage project, upon the combined basis, and give from three or four to even as much as $500 of benefit for each dollar invested?

Mr. Le Prince. We wish to hear from Doctor Carter on this subject.

Doctor Carter. I have only one thing to say, that from the time of the formation of the malaria committee I have thought we ought to tie up our work with that of the large drainage projects, and I judge now it has been done. Unquestionably, the large drainage projects have eliminated a great deal of malaria. They have made some but they have eliminated a great deal more. Also, they have made it possible, by giving a lower level to which we can run lateral ditches, for us to do satisfactory anti-malaria drainage after them. If the engineers of the drainage projects will plan their original work and maintenance work so as to eliminate as much malaria as they can and make as little malaria as possible, I think it is fair to say that the great drainage projects within a few years will lessen the amount of malaria in the Southwest from one to two hundred thousand cases per annum.

I don't know how it is in these States, but I know in Virginia and North Carolina the laws for forming drainage districts are valid only under the police powers of the State. Of course, the object of the drainage project is agricultural, but it is based on the police power of the State in Virginia and in North Carolina as if for the benefit of the public health. They should then do as much for public health as is reasonably and economically possible. I am glad they are doing it.

Mr. Le Prince. Mr. Hidinger will close the discussion.

Mr. HIDINGER. In answer to Mr. Komp's question, I want to say that the proper time to remove tree growth from ditches in this latitude is between June 1 and August 31. At that time the sap in the trees is up and they are more readily killed. As a matter of fact, maintenance work is usually controlled by other factors, primarily by the available labor. In this locality labor does not become freely available until along in July, and until then it is not practical to undertake a heavy maintenance program. We usually make our plans for carrying out the work to begin in May. Our various field engineers begin to circulate among the landowners and find out who will take contracts as soon as their cotton is laid by. Then, also, maintenance work drags along into the fall. We are doing maintenance work now (November 15), and will carry it forward all during the winter in order to keep up with the program. We have some hundred miles of canals to clean in each of several drainage ditches, and it takes time to get all of the work done.

The questions of Mr. Kibbey and Mr. Fisher really cover the same points. It is a fine thing to include your malaria problem—that is, plans for its eradication—in your plans at the time of your organization, but when you consider drainage districts that cover 400 or 500 square miles with 75 per cent of it in the wood, it would be impracticable to do so because money spent for that purpose would doubtless be wasted before the land is settled up and the need for reduction of malaria became urgent.

One point that Mr. Clarke mentioned was that the city council should pay a part of the money to assist drainage districts in malaria control. I do not believe that under the law this can be required. Most of the laws provide that the land shall be assessed, but I do not believe that you can require the city authorities to pay in the Southern States. In some States, Ohio for one, it can be done, but I do not believe it can be done in the Delta regions of the Mississippi Valley.

Mr. LE PRINCE. The next paper on the program is "Seasonal incidence of malaria," by Doctor Bass.

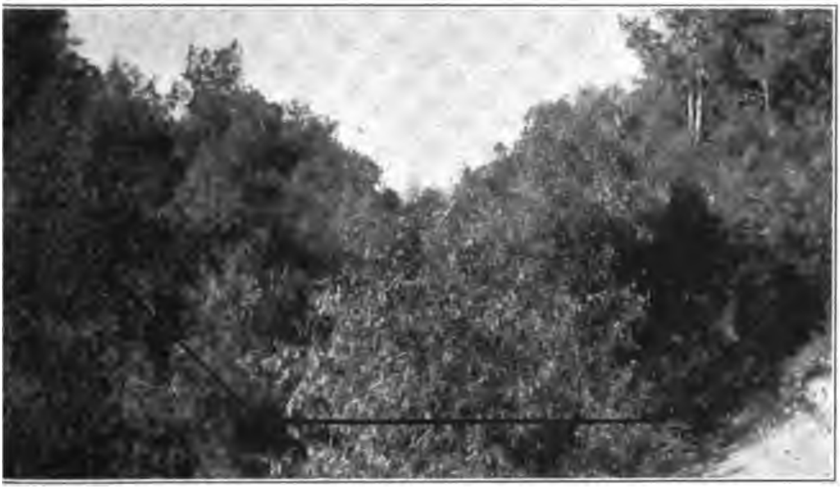


Fig. 1.—Drainage ditch overgrown with willows and other tree growths. Heavy line shows approximate channel section.

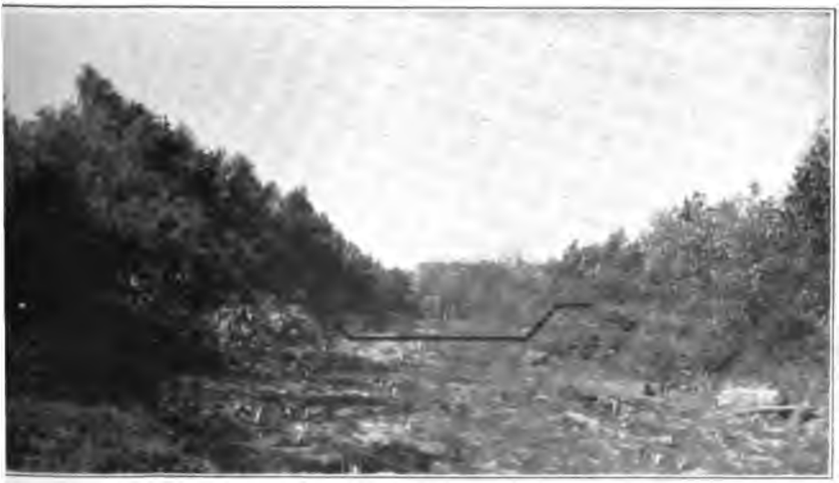


Fig. 2.—Another view of the same ditch after clearing of growth. Heavy line shows approximate channel section.

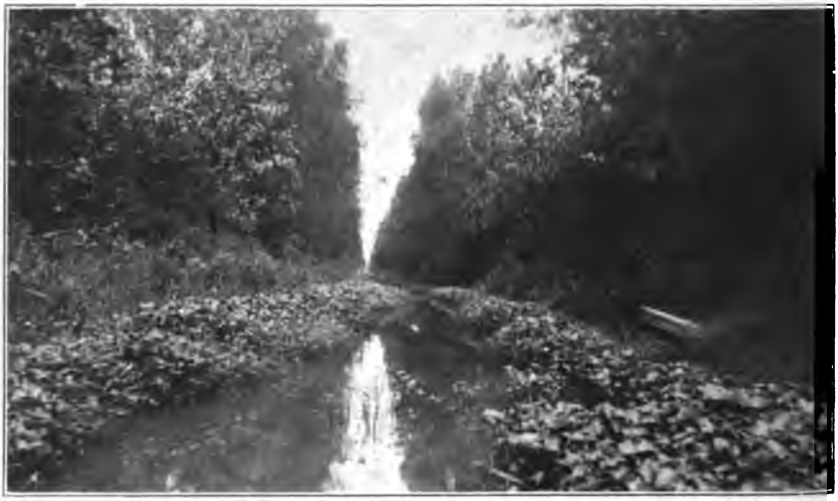


Fig. 3.—Growth of water hyacinth in a drainage ditch. This growth often covers the entire water surface of a ditch in a thick mat which seriously retards the flow of water.

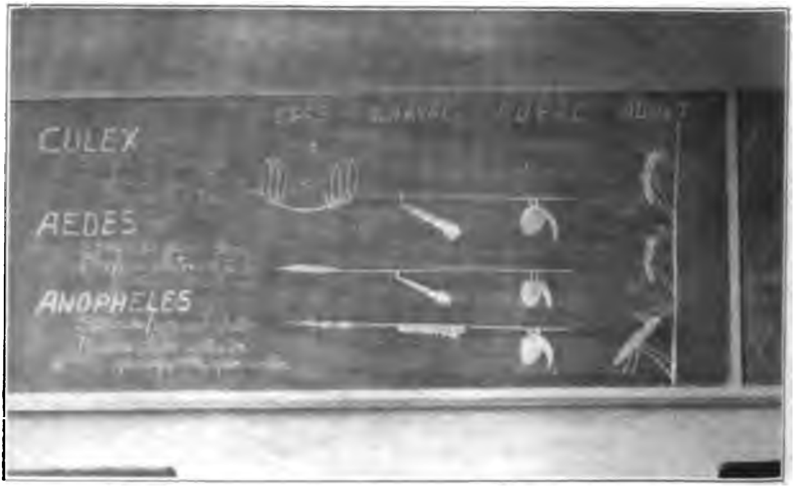


Fig. 5.—Blackboard outline in which labels on the exhibits are explained and distinguishing features indicated.

SEASONAL INCIDENCE OF MALARIA, WITH SPECIAL REFERENCE TO TRANSMISSION.

C. C. Bass, M. D.,

From the School of Medicine, Tulane University, New Orleans.

The seasonal incidence of malaria is very different in different parts of the world. In the southern part of the United States, August and September are the highest months and January and February the lowest. This fact stands out so prominently in all statistical reports of malaria and is so familiar to students of malaria that it is needless to cite detailed figures here. This represents the incidence of clinical attacks of malaria. It does not necessarily follow that the highest and lowest transmission occurs at the corresponding season.

There are two important causes of increase in occurrence of attacks of malaria—from the low period to the highest. One is conditions which favor relapse in persons already infected and the other is conditions which favor production of Anophelines and transmission.

Persons who are infected with malaria and who may have been having clinical attacks from time to time during the warm season tend to quit having attacks just as soon as cold and, in fact, cool weather sets in. This lessened tendency for clinical attacks to occur in infected persons during cold seasons contributes largely to the rapid reduction in malaria cases reported toward the latter part of October. Occasionally a person may continue to have attacks during the cold season, but it is certain that out of a given number of infected persons a very much higher per cent develop clinical attacks during the warm season. This is entirely independent of mosquitoes and transmission. Just how or why cold weather tends to retard the reproduction of parasites in an infected person and warm weather tends to favor it, we do not know.

It is also noteworthy that persons who carry their infections over a period of years, relapsing from time to time, tend to relapse at about the same time each year. A case recently came to my attention of a woman who had simple tertian infection who had had attacks during either September or October each year for a period of five years. It was reasonably certain that this was the same infection contracted five years previously and no reinfection had occurred.

The season may effect transmission by influencing the abundance of Anophelines, their activity, the growth rate and viability of the plasmodia in Anopheles, and the number of gamete carriers in the particular locality.

We know too little about how and where Anopheles pass the winter. We do know, however, by the absence of larvæ in locations where they are abundant during the summer, that little production occurs. Rainfall and lessened evaporation during the winter are generally more favorable for Anopheles production. It seems very probable that the lower temperature is the chief if not the only cause of lessened production. Mr. W. V. King recently told me that they find a few larvæ all through the winter at Mound, La. This shows that Anopheline production does not entirely cease in this region during the winter. However, the number produced is very small in comparison with the number produced during the warm season. Only under some exceptional circumstance could winter-grown Anopheles be an important factor in malaria transmission.

Anopheles not only become less numerous during cold seasons, but they become less active. They come out from their resting or hiding places only during warm spells. Much of the time they are not active, and therefore, if all other things were equal, less transmission would occur in a given period of time. Van Dine (1) had several records of biting by Anophelines at Mound, La., in January, February, and March, both during the day and after sunset in January and March.

Mitzmain (2), in Anopheles infectivity experiments conducted in New Orleans, infected Anopheles with *P. vivax*, and transmitted the infection to 14 volunteers during the months of February and March. These mosquitoes were kept under artificial conditions and protected from rigorous weather, but they were probably not protected any better than they would have been had they passed and survived the same period in nature, as we know some of them do.

Metz (3) reported a heavily infected Anopheles taken December 4. This was one of a number collected near Mulberry and Lakeland, Fla.

That low temperatures do not destroy the parasites in Anopheles is shown by the experiments of King (4). The parasite of tertian malaria in the mosquito host survived exposure to a temperature of 30 ° F. for a period of two days, 31 ° F. for four days, and a mean temperature of 46 ° F. for 17 days. "The sporonts of the estivo-autumnal parasite resisted temperatures as low at 35° F. for 24 hours."

Finally, the number of gamete carriers in the locality may be an important factor in determining the amount of transmission that occurs. During 1917, 45,889 blood specimens were examined for malaria in Bolivar county, Miss., in investigations made jointly by the Mississippi State Board of Health and the International Health Board. Record was also kept of the presence of gametes in the bloods that were found positive, and from this data we have information as to the per cent of infected persons who were gamete carriers, by months. This is shown in detail in the following table:

Per cent of each variety of plasmodia found to contain gametes, by months, 1917; examination of 45,889 blood specimens.

Month.	Tertian (per cent gametes).	Estivo-autumnal (per cent gametes).	Month.	Tertian (per cent gametes).	Estivo-autumnal (per cent gametes).
January	1.64	10.05	August	6.50	39.34
February	2.09	14.50	September	5.74	37.45
March	3.13	29.03	October	2.99	47.78
April	3.17	13.95	November	4.51	37.04
May	3.69	25.42	December	2.90	25.64
June	3.19	27.59	Entire year	3.67	28.72
July	3.91	25.71			

In this table it will be noted that August, September, October, and November are the high months for both the tertian and estivo-autumnal gametes and that January and February are the low months. The much greater number of persons who have clinical attacks and parasites during the high malaria months plus the increase in the per cent of infected persons who have gametes, enormously increases the chances of transmission at this time. It is, indeed, fortunate that the cold season does come along, lessening the activity of Anopheles, slowing development of the parasites in them, and increasing the resistance of the human host to the parasites.

From the information that I have been able to gather and from my own experience, I am led to believe that the following view is about correct:

1. The seasonal incidence of clinical malaria and of transmission varies within fairly narrow limits in different localities in the Southern States.

2. There is no month during which Anopheles are entirely absent or may not bite and either become infected or transmit infection. However, during cold weather the numbers of Anopheles are much reduced, their activity is much less, the development of parasites in them is much slower, and the greater resistance of persons to reproduction of parasites during cold weather all tend to make what transmission that may rarely occur of negligible importance when compared with warm months. The months during which almost no transmission occurs are November, December, January, February, and March.

3. There is less transmission during the early, warm months in the presence of a given abundance of Anopheles than just following the peak in August or September. The chief cause of this is the smaller number of infected persons at this season than later. The amount of transmission bears a direct relation to the number of gamete carriers as well as to the abundance of Anopheles.

4. The rise in malaria incidence to the high point in August or September is the result of the cumulative effect of increasing numbers

of gamete carriers in the presence of sufficient and perhaps increasing numbers of Anopheles, plus some unknown factor which favors reproduction of the parasite in the human host at this time.

REFERENCES.

(1) Van Dine, D. L., The destruction of Anopheles in screened dwellings. Southern Med. Jour., vol. 14, No. 4, 1921, p. 289.

(2) Mitzmain, M. Bruin, Anopheles infectivity experiments. Public Health Reports, vol. 31, No. 35, 1916, p. 2325.

(3) Metz, C. W., Anopheles crucians Wied. as an agent in malaria transmission. Public Health Reports, vol. 34, No. 25, 1919, p. 1357.

(4) King, W. V., The effect of cold upon malaria parasites in the mosquito host. Jour. Exp. Med., vol 25, No. 3, 1917, p. 495.

DISCUSSION.

Mr. LE PRINCE. The subject is open for discussion.

Doctor BARBER. I wish to ask just two questions of Doctor Bass. One question is, Has he noticed a spring rise in March or April; and the second is, If the transmission of malaria varies greatly from year to year in a given locality. During this year in Mitchell County, Ga., I should say that the transmission of malaria must have been at its minimum, if it occurred at all, on account of drought and the consequent scarceness of Anopheles. In India and in some other tropical or semitropical countries they have what they call the fulminating type of malaria, meaning a very heavy attack in a certain year. This year may be followed by a period of years with relatively light incidence of malaria. I wonder if in this country the amount of malaria may not depend on the available number of susceptible persons as well as on the amount of Anopheles production. I should like to have the doctor discuss this phase of the subject.

Doctor BASS. In answer to Doctor Barber's first question, it is my impression that there does occur a spring rise in this country due largely to tertian malaria. It seems that for some reason or other, spring and early summer are more favorable for the development of tertian parasites in man, and late summer and fall are more favorable for estivo-autumnal. As a result, those who carry the infection through the winter are more likely to relapse in the spring if they have tertian. If they have estivo-autumnal they are more likely to develop attacks later. Of course, mosquito abundance at this season is also an important factor in production of the usual spring rise.

With reference to Doctor Barber's second question, the number of persons who have malaria in a locality during a year or season depends, as is well known, upon two important conditions—the number of malaria carriers and the abundance of Anophelines. These conditions may, and usually do, vary from year to year, resulting necessarily in variation in the prevalence of malaria. Variation of one of these conditions in one direction and of the other in the other direction may result in little change. Variation of both conditions in the same direction would result in a corresponding decrease or increase of malaria occurring in the locality. The prevalence of malaria in a given locality is the product of the carrier population who can infect Anophelines, multiplied by the abundance of Anophelines which can transmit the infection. No doubt there are unknown factors affecting both of these.

Mr. LE PRINCE. The subject is open for further discussion.

Doctor CARTER. I would like to ask Doctor Bass what proportion of the early malaria that comes in the spring before the first flight he considers to be due to infection from the hibernating females by the carriers that they find and what proportion to relapses.

There is no question about the early spring rise of malaria. Tertian is more apt to relapse than the æstivo-autumnal, and it is reasonable that you expect it to occur in the spring from relapses. The female Anopheles hibernate, and they then have access to these carriers and may make the early spring infection. There is a rise early in some places in the United States; in South Carolina and in North Carolina and Virginia it comes in the early part of April and then a much higher rise in the early part of June. I should ascribe the first rise partly to relapses and partly to infection from hibernated females infected since hibernation and the second rise to infection from new brood.

Doctor BOWERS. I would like to ask Doctor Bass if the unknown factor to which he refers may not be the condition of underoxidation, which we know is much more prevalent in the debilitating hot months than in colder weather. We all know that in most of our cases where the weather becomes colder the patient can oxidize much more rapidly, and it occurs to me that perhaps this unknown factor to which Doctor Bass refers may have its basis in this matter of underoxidation in warm weather.

Mr. LE PRINCE. May we hear from Doctor Deeks?

Doctor DEEKS. There are one or two points in Doctor Bass's paper than interested me very much. In the first place, when one gets malaria he may develop a temporary immunity, and that immunity may last for years and he may never be ill. In Panama, where in the early days undoubtedly everyone had malaria, I don't recall ever being called in consultation to see a case of malaria except when that patient had an accident or was subjected to anesthesia, which lowered his resistance. Now, we have to take into consideration the individual resistance of the patient; and as long as the patient is in a run-down condition you can not cure him of malaria. That point is proved when an accident occurs or an anesthetic is given. A man who has absolutely not suffered from malaria in years will develop symptoms. That happened in Panama patients who had not suffered from malaria in years and did not know they had malaria. They would come north for a change of climate, and would come down with malaria. I think, Doctor Carter, in going over some of the villages in Panama you found a number of cases of malaria who were apparently not ill.

Doctor CARTER. Eighty-seven.

Doctor DEEKS. And a lot of those people were not suffering from a malarial attack. They carry the parasites, so when you get your spring rise they can easily transmit them. When you have an accumulation, an increased number of carriers, you are going to have more malaria than in the winter when you have increased resistance.

In the Tropics at the present time we get most of our malaria cases in the wet season, and in the dry season we get very few of them. But we must not overlook the fact that natural resistance plays a tremendous rôle. If a patient has malaria and you want to cure him, you must increase his resistance; you must do that as well as give quinine, which destroys the organisms, if you are going to cure your patient.

Mr. LE PRINCE. Will Doctor Bass kindly close the discussion?

Doctor BASS. In answer to Doctor Carter's question, I have no data from which to draw absolute conclusions. My opinion, however, is that it is likely that malaria parasites may be carried through the winter by overwintering Anophelines, but that this is of negligible importance in the production of the spring rise. This is due chiefly to relapse in persons who have carried the infection through the winter plus transmission by mosquitoes that may have lived through the winter, but become infected early from these carriers.

I agree with Doctor Deeks that lowering the resistance or vitality of an infected individual may result in his developing clinical symptoms when he otherwise would not. I do not agree, however, with his suggestion that the resistance must be raised to cure such patients. My opinion is that there are no cases of malaria that can not be cured by giving quinine in sufficient quantity for sufficient length of time. You don't have to give him anything else.

Mr. LE PRINCE. The meeting is now adjourned until 2 o'clock sharp.

Afternoon Session, November 15, 1921.

Mr. LE PRINCE. The first subject on the program this afternoon is "Use of dynamite and T. N. T. in blasting ditches." Mr. Clarke.

THE USE OF DYNAMITE AND T. N. T. IN BLASTING DITCHES.

J. L. Clarke,
Sanitary Engineer, International Health Board.

Before taking up the procedure of blasting ditches with T. N. T. by the use of straight dynamite as a propagating agency, I want to define briefly the field in which the blasting of ditches may be resorted to with a decided saving over other means of construction.

Defining field of usefulness.—From an economic standpoint its scope of usefulness lies in a field between the points where ditching machinery and hand labor reach their limitations.

I predict that ditch blasting will play an important rôle as a means to better sanitation in towns and as an aid to rural sanitation through agricultural drainage.

In the field of urban sanitation, especially in small cities and towns, it may be resorted to for the construction of outlet ditches. where the job is too small for ditching machinery, too wet for team work, and too costly for handwork.

In the field of rural sanitation, particularly for construction of short lateral ditches, more or less isolated it may be relied upon, for in such instances it takes up the work of drainage where the dredge leaves off.

Where other methods are not applicable.—For the purpose of defining more accurately this field, we may assume that the cost of setting up the smaller type of walking dredge is at least $1,200. This would mean at least a mile of blasted ditch could be constructed for the same cost, and, further, that 2 miles could be constructed before the contractor would have a chance to come out from under his overhead cost and start to make his profit. Lateral ditches at least 2 miles long may be eliminated from dredge work. The cost for this class of dredge work would be 20 to 30 cents per cubic yard for small jobs and 15 to 20 cents per cubic yard for large jobs.

The next step would be to consider teamwork where the ditch is to be constructed through dry soil and its cost balanced against that of the ditch blasted by the electric method. The cost of teamwork would be 15 to 25 cents per cubic yard plus the additional cost of blasting stumps through timbered land, but if the soil conditions be too wet for teamwork, there would be a possibility of using hand labor. Hand labor under wet-soil conditions, and where stumps are frequently encountered, would cost at least 80 cents to $1 per cubic yard. Under the last-named wet-soil conditions blasting materials may be used to a decided advantage. Conditions are ideal, as both stumps and ditch may be blasted in the same operation by the propagated method, using either T. N. T. and dynamite or dynamite alone. The cost of blasting a ditch under wet-soil conditions would be 15 to 20 cents per cubic yard.

Stream correction—Choice of methods.—For the purpose of straightening crooked creeks channels, the blasted ditch has a definite place for streams of widely variant characteristics. Streams having little grade are apt to be too wet for teamwork and too costly for hand labor because the ground water will be near the surface and forestall the digging of a deep ditch, which is essential for work of this character. Here the ditch may be constructed by the propagating method because of the presence of water or moist soil, which will be usually found in the lower stretches of these streams. On the other hand, streams having absolutely dry-soil conditions suitable for teamwork are likely to have a grade of 10 or more feet per mile. On such a grade erosion takes place rapidly, and flood water will construct the ditch if a straight channel is once started, and by creating a shorter and more direct descent, the velocity or flow will be increased. Such meandering channels may be straightened by planting the explosives deeper and farther apart than usual.

Design of blasted ditches—Flat grade.—Some restriction should be placed on the design of blasting ditches. Where the grade is less than 3 feet per mile, explosives should be placed close enough together, shallow and heavy enough, to remove all earth from the ditch, leaving clean, uniform banks, for no erosion can be depended upon. In fact, a small ditch having a grade of 2 feet per mile or less will silt up quickly, especially where lateral ditches empty into it.

Steep grade.—As erosion of ditch banks increases directly as the fall of the stream, ditches having a grade of 10 feet per mile or more will scour out automatically, thus causing the desired cross-sectional area. This class of construction would call for heavy charges placed 3 or 4 feet apart and 5 or 6 feet deep. With such extreme spacing, the method of priming charges with electric caps must be used. The resulting ditch will be a series of potholes, with loosened earth between them and 5 or 6 feet to each side. While the result will by no means be a finished ditch, nor will it look to be good construction, it is all that is necessary, for the flood waters will scour this channel, under favorable soil conditions, finishing the job.

The main consideration in straightening a stream channel is to have the deep, narrow ditch, and it should be remembered that shallow, wide ditches slow down the velocity of flow, while deep narrow ditches increase the velocity. Here the idea is to get a maximum velocity in order to erode the ditch until it has become large enough to take care of ordinary flood conditions. In the construction of the above-described ditches, the depth of charges should be governed by the drainage area of the stream and its rate of fall, because the volume of water, together with the grade of the stream, determines its power to carry eroded materials in suspension.

After describing the method of firing T. N. T. for ditch blasting by the use of dynamite as a booster, and analyzing the items of cost, I want to touch again on the erosion of blasted ditches and cite such instances as have come under observation.

METHOD OF FIRING T. N. T. AND DYNAMITE.

Referring to field test shots, made by Mr. W. B. Alford, agricultural representative of a large powder company, and myself to determine the practicability of substituting straight dynamite as a propagating agency for detonating T. N. T. in lieu of caps, I wish first to state what prompted our experiments:

Purpose.—In view of the fact that the Department of Agriculture has made available large quantities of blasting materials in the form of T. N. T and picric acid for distribution among the farmers of all the States, and that this material is packed in standard dynamite form and is being used for land clearing, it has been thought advisable to make actual field tests for ditch blasting as well as land clearing, for which it has been recommended.

Cheapness of T. N. T.—The cheapness in first cost (packing, charges, and freight) of T. N. T. and of picric acid tends to promote new work in land clearing, new ditches blasted, and the maintenance of large drainage canals. The attempt to use T. N. T., fired by priming each charge with an electric cap connected in series where water exists, has caused failures and has made the work very expensive in labor costs, due to recharging and reshooting. Therefore, in an effort to reduce the two main items of costs, which are labor and caps, the following tests were made, using a small quantity of dynamite in connection with T. N. T. to determine if it might be propagated by this method rather than by using electric blasting caps connected in series in each charge, as has been recommended by the Government bulletins. This would substitute a small quantity of dynamite in lieu of the cap, as an aid to detonation, necessitating only one No. 6 electric blasting cap as a primer, detonated by a No. 2 blasting machine, making this method one of absolute propagation, firing 100 to 300 feet each time. Thus one stick or half-pound cartridge of 50 per cent dynamite, which is the quantity recommended, is more effective, has better detonation power, and at the same time will shatter the top soil, lifting it well back, giving the T. N. T. an opportunity to heave out the bottom in good form.

Comparative methods.—Test shots given in the following table of costs show comparative costs of T. N. T. fired by priming each charge with a No. 8 electric cap, connected in series and fired by a No. 4 blasting machine which detonates 50 charges at a time. This is the usual method of firing T. N. T. and ammonia dynamite. In comparison with this, it is proposed to substitute one cartridge or one-half pound of 50 per cent nitroglycerin dynamite for the No. 8 electric blasting cap, using only one No. 6 electric blasting cap as a primer, in a line of holes from 100 to 300 feet in length, loaded with T. N. T. and dynamite (two sticks of T. N. T. and one of dynamite instead of three sticks of T. N. T.). This is the usual distance recommended to be blasted by the propagated method.

Electric methods safer.—It is safer to use electric caps and blasting machine in preference to the cap and fuse method, as the soil must be water-soaked in order that the propagated method may be successfully used. The cap and fuse is apt to become water-soaked, causing a loss of time and danger in returning to recharge misfires. In using the propagated method a No. 2 blasting machine capable of firing 10 caps would be sufficiently large.

Cut-offs caused by log jams and stumps.—In some cases when heavy overburdened log jams and stumps are encountered in the ditch line, detonation by concussion will frequently cut off, firing only a portion of the loaded holes. Where such obstructions are found, it is advisable to use two or three electric caps for each 200 or 300 feet loaded. The caps should be connected in series and fired with a blasting machine. This will carry detonation all the way through, but is not necessary unless such obstructions are encountered. In most cases just one priming is all that is necessary.

Field conditions controlling test shots.—The following tests were made at Greenwood, Miss. The soil conditions are practically the same as those existing in the bottom of large drainage canals throughout the Delta section, the soil being of the buckshot or gumbo type, thoroughly soaked with water, and in a majority of cases water standing 6 inches to 1 foot in depth over the surface. The project on which these test shots were made consisted of deepening an old dredge ditch 20 feet wide and 10 feet deep for a distance of 5 miles to an average depth of 4 feet additional, with 12-foot top and 4-foot bottom, and at the same time removing the silt deposits formed where the lateral ditches joined the main canal and log jams in places throughout the canal.

Comparative costs.—By the all T. N. T. method, a No. 8 electric blasting cap was required for each charge, meaning 50 caps in each

100 feet of ditch, charges 24 inches apart. By the substitution of one stick of dynamite for one of T. N. T. to detonate, only one No. 8 electric blasting cap is necessary to shoot from 100 feet, or, if desired, 300 feet, by the concussion or propagated method.

Referring to the test shots under the heading of costs per 100 feet, it will be noted that under labor, where electric blasting caps were used in each charge (test No. 5—all T. N. T.) the cost is about 6 cents per foot, whereas in the case of dynamite as an aid to detonation for the T. N. T. this cost is reduced to 1¼ cents (test No. 2). The cost of one electric cap is 8 cents and cost of one cartridge, or one-half pound of T. N. T., is 4 cents, making a total of approximately 12 cents for cap and cartridge. The one cartridge, or one-half pound of dynamite, is substituted for both the electric blasting cap and the primed stick of T. N. T. and costs the same—approximately 12 cents.

The dynamite fires by the concussion or propagated method, and in turn detonates the T. N. T. more completely than does the electric cap, and in addition thereto eliminates the cost and time of priming the cartridge, of connecting 50 caps in series, of tracing the cause of misfires, and reshooting same.

Furthermore, the relative expansive force of one cartridge of 50 per cent dynamite is greater than that of one cartridge of T. N. T. It is quicker and has a tendency to shatter the top stratum before the T. N. T. has gained force to lift out the bottom strata, thus giving a wider, a larger, and more uniform ditch with a wider berm than made with T. N. T. alone.

In addition to the advantages mentioned under costs, it is well to consider under the head of man-hours that the work can be speeded up 200 per cent by the use of dynamite as an aid to detonation.

Comparing the cost of the two best test shots, namely, Nos. 2 and 5 (respectively T. N. T. plus dynamite and T. N. T. plus caps), shown on the test sheet to be $660 and $844, there will be a saving of $184 per mile in favor of dynamite used in connection with T. N. T. Also note under these two tests the amount of material moved in cubic yards as against the cost per cubic yard.

T. N. T. completely detonated.—After making the above test shots, it was thought that possibly the T. N. T. was not detonating and that the dynamite was doing all of the work; therefore, to determine if this were the case, 20 cartridges of dynamite placed at 24-inch spacings were detonated by the propagated method. Detonation was complete, but gave a ditch only about one-third the size of T. N. T. and dynamite used together, proving that the T. N. T. had been thoroughly detonated in all test shots where dynamite was used in connection with T. N. T.

DESCRIPTION OF BLASTED DITCHES.

Test shot No. 1.—Propagation was thorough throughout the entire length and detonation was apparently perfect. The soil was broken in small lumps and carried high in the air, leaving a clear berm and a uniform ditch.

Test shot No. 2.—This shot was very similar to No. 1 in detonation and uniformity, but the larger clods were left lying several feet from the ditch bank. This is considered the best and most economic shot of the test shots made.

Test shot No. 3.—This shot resulted in a ditch practically the same size as No. 2. It might have been deeper, but was not as clean, large clods being left on the sides. This spacing seems to be the limit for good work.

Test shot No. 4.—This shot was loaded with T. N. T. and holes spaced at a maximum distance, using dynamite to aid detonation. as in tests 1, 2, and 3. One primer failed to propagate the entire line: another was required. The loading was heavy enough to give a clean, uniform, wide ditch at top, some deeper, but is not recommended on account of failure to propagate.

Test shots Nos. 5, 6, and 7.—These tests were made by using T. N. T. with No. 8 electric blasting cap—6-foot wires—connected in series and fired with a No. 4 blasting machine, firing 50 holes at each shot. Nos. 5 and 6 resulted in a fairly good ditch, although narrow at bottom and of uniform depth, except where misfires occurred, which were frequent. Neither were the banks lifted back as completely. No. 7 resulted in a badly potholed ditch. No one of these shots lifted the soil as well back nor shattered it as completely as where dynamite was used to aid the detonation of T. N. T.

COST OF WORK AT GREENWOOD, MISS.

At Greenwood the canal described above has a grade of 2½ feet per mile and a flat drainage area of only 6 square miles. Therefore it was necessary to remove all material from the ditch and not depend upon flood waters to scour it.

Final cost of T. N. T. ditch.—The figures given are for 3½ miles of ditch, 1.3 miles of which were blasted with T. N. T. alone, fired by the electric method, and 2.2 miles of which were blasted with T. N. T. and dynamite by the propagated method. The costs given above are for field tests for 100-foot length shots, while below the cost items are based on 3½ miles of actual operation.

The average cross-sectional area of the ditch blasted with T. N. T. is 17 square feet, 7 feet wide at top, 3 feet wide at bottom, and 3.7 feet deep, approximately two-thirds of 1 cubic yard per running foot.

The total amount of material removed from the ditch was 4,322 cubic yards. The cost was 35.4 cents per cubic yard.

The charges were placed 2 feet apart, loading 1.5 pounds of T. N.T. and one electric cap for each hole, but owing to misfire a cap was used every 18 inches and the charges increased to 2 pounds of T. N.T. per hole.

Final cost of dynamite and T. N. T. ditch.—The average cross-sectional area of the ditch blasted by T. N. T. and dynamite is 26.4 square feet, 8.7 feet wide at top, 5 feet wide at bottom, and 4 feet deep, approximately 1 cubic yard to the running foot. The total material removed is 11,321 cubic yards. The cost is 17.6 cents per cubic yard, or $905 per mile.

The standard loading was 1½ pounds of T. N. T. per hole, with one-quarter pound of 50 per cent straight dynamite placed on top of it. Holes were spaced 18 inches apart. Owing to accumulations of trash, logs, and extra depth at points where the canal had become silted, about one-third more dynamite was used than its regular 18-inch spacing called for.

The field force consisted of one foreman, at $5 per day, and six men, at $2 per day each, and one cart and mule furnished by the city. This crew averaged 1,000 feet of blasted ditch per day. Two shots of 300 feet in length each were made in the forenoon and two in the afternoon.

Costs of stream correction on steep grade.—Coming back to the erosion of blasted ditches, I want to call your attention to two ditches in particular—one at Batesville, blasted through the sandy clay alone, having a grade of 10 feet per mile, and the other at Water Valley, blasted through a sandy loam, having a grade of 6 feet per mile.

The Batesville ditch after the first year's flood increased in top width from 8 to 18 feet and in depth from 3 to 7 feet. The cost per cubic yard of blasting this ditch with T. N. T. by the electric method was 23 cents per cubic yard.

The Water Valley ditch was scoured by flood waters from a mass of loosened earth 12 feet at top and 7 feet deep to 40 and 15, respectively. This ditch is about 1,500 feet long, and connects Town Creek with a large drainage canal. The cost of loosening up the earth was about 15 cents per cubic yard, and after one year's flood water had passed through it the original cost was reduced to 2 cents per cubic yard, due to the erosion which had taken place during the winter months.

In concluding these remarks, I want to point out several facts, namely, that dynamited ditches are not in competition with dredge work, teamwork, or hand labor, but are an aid to complete drainage to both large and small projects, because dynamite covers a field specifically its own. It is the duty of the engineer to determine this field.

That there are two general classes of work where dynamiting is applicable—wet swamp work and dry stream connection work—and that there are two methods of firing dynamite—the propagated method and the electric method—is an acknowledged fact. The former should be used for wet work and the latter for dry work. Where time is the essence, ditch work may be speeded up from 200 to 400 per cent by using explosives. In the work of malaria control, time is often an important factor, for the major drainage should be accomplished during the early spring.

Field tests made with T. N. T. and dynamite for blasting ditches.

Number of experiments.	Length, test shots.	Spacing of holes.	Loading in pounds per hole.		Depth of loading in inches.		Man-hours.	Costs per 100 feet.					Cost per mile.	Material moved (cubic yards).	Cost per cubic yard.
			T. N. T. 50 per cent.	Nitroglycerin dynamite.	Bottom.	Top.		Labor.	T. N. T.	Dynamite.	Cap.	Total.			
1.....	100	18	1.0	½	34	10	4.5	$1.58	$5.42	$8.26	$0.07	$15.33	$809	118	$12.99
2.....	100	22	1.0	½	34	10	4.3	1.51	4.32	6.60	.07	12.50	660	100	12.50
3.....	100	24	1.5	½	42	10	3.9	1.35	6.00	6.06	.07	13.48	711	100	13.48
4.....	100	30	2.0	½	50	10	3.7	1.30	6.40	4.90	.07	12.67	669	118	10.58
ALL T. N. T. USED WITH NO. 8 ELECTRIC CAP IN EACH CHARGE.															
5.....	100	24	1.5	......	34	10	17.1	$6.00	$6.00	......	$4.00	$16.00	$844	70	$22.86
6.....	100	24	1.5	......	34	11	11.4	3.00	6.00	......	4.00	13.00	686	70	18.57
7.....	100	36	2.0	......	42	10	14.3	5.00	5.28	......	2.64	12.92	682	(1)	(2)

Size of ditch desired—12-foot top, 4-foot bottom, 4 feet deep.

[1] No ditch.
[2] Pot holed.

DISCUSSION.

Mr. **Le Prince.** Before the discussion starts there are one or two announcements to make. I wish to call the attention of everybody present to the "Public Health Engineering Abstracts" being published by the United States Public Health Service, which may be obtained by writing to the Surgeon General in Washington. They contain very important information, and are well worth reading.

The discussion on this subject will be opened by Mr. Alford.

Mr. **Alford.** Mr. Clarke has read to this body a report covering the above subject, and I am passing around to you some photographs which are evidence of some of the work that has been done in Georgia, Alabama, and Mississippi.

The land where Sapelo Island ditch was made was a very hard coastal plain sand and very little grade, only about 1 foot to the mile.

This was an old ditch made on Sapelo Island about 118 years ago. It was dug by hand, using slaves as laborers. The dirt was thrown out on each side, forming a very high spoil bank, and while it had filled up almost entirely, the old spoil banks were preserved. Looking down the old ditch, you would be led to believe it had some depth, but the contour of the bottom of the old ditch was almost the same as the lands on each side of the banks. The tide had ebbed and flowed, and it was filled in with silt and had grown up with bushes and small trees.

You will note in Mr. Clarke's report most of his work in Mississippi was done on stiff gumbo or buckshot land, and most of it was done by use of dynamite and T. N. T. or T. N. T. only.

But the Sapelo Island ditch was hard coastal plain sand, as I have said, and was made with dynamite alone.

We used 1¼-inch octagon-shape steel bars for putting down holes, and in this kind of sand it was impracticable to drive the bar down with sledge hammer, but if you would work the bar back and forth it would work its way down with ease. As the bar was pulled out the hole was immediately loaded to prevent access of sand, using a tamping stick to pound it down, putting three sticks or 1½ pounds of 50 per cent nitroglycerin dynamite every 20 inches apart.

Only one line of dynamite was used, loaded to a grade line in bottom and to a grade line at surface. In other words, it was loaded down to 18 inches of the proposed bottom of the ditch and within 18 inches of the top of the ground. (See chart on loading.)

You can not always do this as well in ground as on paper, but if you will cut notches on the tamping stick and use this as a measure, it will help you to get uniformity.

It has been said that you never know what dynamite will do; but this applies to certain classes of laborers, too. You never know what they will do; but if the line is loaded by this method with accuracy, you will get uniformity in ditch.

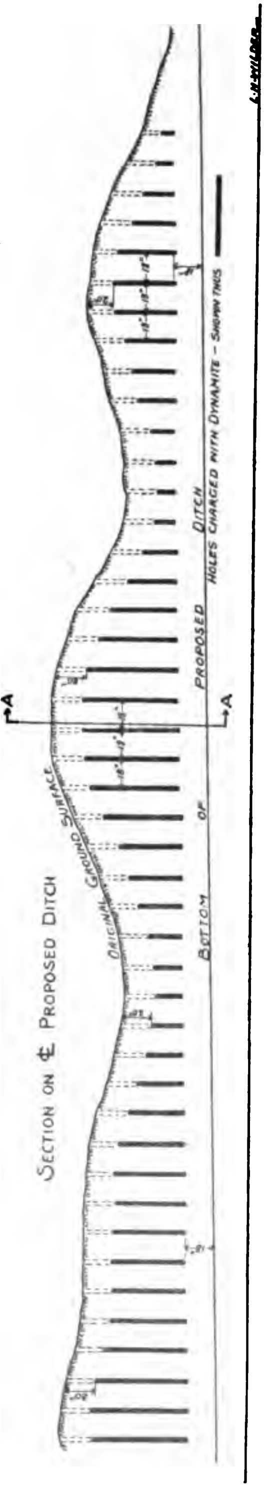

Section on ℄ Proposed Ditch
Original Ground Surface
Bottom of Proposed Ditch
Holes charged with dynamite - Shown thus
A
A

FIG. 4.—Profile showing proper placing of dynamite.

Your depth of loading and spacing of holes depends largely on character of soil.

If it is in very hard sand or gumbo soil, loadings should be placed closer together to get detonation by the propagated method, but if in silt or leaf mold it will detonate much farther apart, and in all cases the ground should be wet or moist where work is to be done by the propagated method.

If stumps are to be encountered the load should be increased in proportion to size of stumps, placing it around stumps close enough together to assure propagation.

To make given size ditches you should use dynamite as follows:

Say, for making a ditch 7 feet wide and 3½ feet deep, we would use one stick, one-half pound of 50 per cent nitroglycerine dynamite. placed about 15 to 18 inches apart, and to get a ditch 15 feet wide and, say, 6 feet to 7 feet deep, we would use about three cartridges to each charge. This, of course, means ditches 7 and 15 feet wide at top as dynamite will always work out on about 1 to 1 slope. In sandy soil it works out on V-shape; in stiff soil it works out on U-shape. (See chart as to method of loading.)

Mr. Le Prince. Questions are in order. It is a very important subject. Some of you have had difficulties and you can ask questions pertinent to that. I will start things going by asking Mr. Alford to tell us something with regard to vertical drainage. It is not the subject, but related to it.

Mr. Alford. As to borrow pits I have no information to offer, but have had some experience in draining upland ponds by shooting with dynamite, known as "vertical drainage." Most of these upland ponds are found in the highlands of Georgia, South Carolina, and Alabama, frequently found in the center of large fields of 100 to 200 acres in size. These ponds usually cover from one-half to 3 acres.

They are usually impracticable and almost impossible to drain with lateral ditches, as these ditches would necessitate great depth through cuts in hillside and great length. These ponds cause turn-around places in the center of a field and are eyesores to a farm.

We do not like to go on record too strongly on vertical drainage because so much depends on grade of soil, surrounding water table, and depth. It is necessary to find a stratum of sand underneath, but we do say that in most cases it is worth trying as the cost of breaking the hardpan with dynamite would be small.

In putting down holes for vertical drainage I use an ordinary 1¼-inch water pipe, sharpened and tapered at one end like a pencil point and in lengths of about 10 feet each, so as to be coupled together. Two men can use this as a churn drill, continuing to churn it up and down, using water in the hole, until proper depth is reached. This should be determined by the underlaid stratum of coarse sand, and in many cases a depth can be decided on by noticing the depth of such stratum in near-by wells or similar excavations in the vicinity, but I would not figure it practicable if this stratum of sand is more than 30 feet deep.

After a hole has been put down I would use half a stick of dynamite placed in the bottom of the hole after being primed with No. 6 blasting cap and fire it to spring the bottom of the hole.

Then I would fill the pothole with dynamite, which will take approximately 10 to 15 sticks. Then fill the remainder of the hole with dynamite, one stick on top of another, to within about 2 feet of the top of the ground. Then place primer and, upon firing, the entire load will detonate. This will make an open well 3 to 4 feet in diameter, and will break ground for several feet around. Then fill the hole with stone chunks or any kind of débris. One shot will usually drain about 1 acre of ground. You will have to use more shots where the acreage is larger than 1 acre. This will cost from $3 to $8 per shot, depending on the depth required.

Mr. Old. I believe Doctor Coogle had some experience with vertical drainage at Camilla.

Doctor Coogle. This pond was about 30 by 60 feet and about 6 feet deep in the center. With a special auger (property of the United States Public Health Service), we bored a hole 6 inches in diameter and 30 feet deep. Into it we dropped 12 sticks of 50 per cent dynamite. The first trial failed to explode the charge; immediately another cap was properly fixed into a stick of dynamite and lowered to the original charge (the hole had been filled with water, so it was an easy matter to get the last stick and cap in direct contact with the first charge). At the second attempt the charge fired, the ground was cracked up around a considerable area, and there was a temporary lowering of the water of some 6 or 7 inches.

The experiment was conclusive that this measure was not feasible in that character of soil.

Mr. Clarke. Mr. Alford has explained the method of placing dynamite in hard soil, both in buckshot and in hard sand. I would like to have him explain how these charges are placed in wet soil—whether it is necessary to place them as deep or not.

Mr. Alford. I wish to refer to the ditch made with Mr. Carter in Alabama and also the ditch made with the Seaboard Air Line in Savannah, both being in very mucky soil growing in cat-tails, small turfs, and bushes where it was almost impossible to walk and where you would jump from turf to turf. The ground would shake for 30 feet around and entire land was almost entirely covered with water.

In this character of soil we used tub boats for men to push about, carrying dynamite to load the ditch. Load the dynamite very close to the top of the ground. There is hardly any need for a bar for putting down holes. We used a tamping stick to push the dynamite under the surface not to exceed 8 inches.

In this kind of soil if you should load dynamite any deeper than 8 inches you would not get any ditch at all, as the dynamite would automatically shoot down and out, pick up much more earth than could be thrown out, and would break the sides and run back together. If you load fairly light and near the top, you will get a fair ditch. If more depth in required, it is better to do what you can with a small load, making a shallow, but wide ditch, taking off as much water as possible, and then after it has settled and dried out a second shot can be made.

In all cases where T. N. T. is used alone it will be found necessary to use a No. 8 cap instead of a No. 6. However, a No. 6 cap will be satisfactory if a half stick or a stick of dynamite is used with T. N. T. or picric acid.

A ditch was made at Millen, Ga., under the supervision of Mr. H. N. Old. This was a stretch of 1,500 feet of ditch, made with dynamite, using eight men, making 1,500 feet in five hours. The loading was done as already outlined, using one stick of dynamite to each linear foot with a slight increase on big stumps, making it at a total cost of about 27 cents per cubic yard.

In the Millen ditch large black gum and sweet-gum stumps were encountered with some roots left protruding over the ditch. Where stumps are encountered and roots are left protruding in the ditch, if you will leave them for about four to six months they will die and become brittle, like cork, and can be easily broken off and thrown out of the ditch.

A ditch made near Atlanta, Ga., was in a silt soil washed in from hilltops. It was a stream correction ditch, and while the soil where the ditch was made was almost dry enough 12 inches down to plow, it was found that it was wet enough underneath to shoot dynamite by the propagated method.

This was determined by making a few test shots before deciding the amount of load to use. We then put holes down 2½ feet deep or as near to the grade line as we could with about 17-inch spacings and loaded two to two and one-half cartridges, or 1¼ pounds of 50 per cent nitroglycerin dynamite, to each charge. We used four laborers and finished 1,011 feet of ditch, measuring 12 feet top, 4½ feet deep, and about 1 to 1 slope in five hours, using 910 pounds of dynamite. The cost amounted to about 22 cents per cubic yard, not allowing for scouring out by flood waters. This old stream was also dammed before the shot was made, and the water passed entirely through the new ditch as the crowd looked on. This ditch was made for demonstration on November 12, 1920, on the farm of Hugh Richardson, Atlanta, Ga., for the benefit of those attending the meeting of the National Drainage Congress held in Atlanta at that time.

Mr. Le Prince. Mr. Clarke, will you close the discussion?

Mr. CLARKE. I want to check Mr. Alford on the placing of dynamite in moist soil. At Newport News in the beginning, and later, I attempted to blast ditches in a salt-water marsh. My first shots were placed 3 feet deep. The soil went up high. It looked to be a good shot, but upon examination I found that the dirt had fallen into the ditch again. I placed the charges deeper on the next test shot and the same thing occurred. Finally, the test shot was made in the turf, which was a tough mass of roots possibly 12 to 14 inches thick, about 4 or 5 inches below the surface, where the point of greatest resistance came. That gave an absolutely perfect ditch in the salt marsh. The cost of the work, as I remember it, was about 13 cents per cubic yard.

I also want to check Mr. Alford on placing charges within 18 inches of the proposed grade line in heavy soil and loading the holes to within a foot of the top.

My advice to those who have not tried to ditch by dynamite would be to try it, and if not successful the first time try it again. Test shots should be made at the beginning of all projects of any size, and the best results should be determined right then and there in the field and instructions given to the foreman. The depth of the charges and the spacing should not be changed until different soil is encountered; then more test shots should be made.

Mr. ALFORD. I would like to ask a question. Mr. Clarke, did you find in loading in the marsh to get your ditch through that it was necessary, if you got a ditch more than 4 feet deep, to load and do the best you could to drain this area with that shallow ditch? Did you let it stand for some time, carry off the water, and then drain the bottom off?

Mr. CLARKE. That was the largest ditch shot, with charges placed 18 inches apart. A single stick was sufficient to make a ditch about 8 feet at the top and 3 or 4 feet deep.

Mr. ALFORD. Well, I mean if you wanted it 7 feet deep. You couldn't possibly get it deep enough because your load would be too heavy.

Mr. CLARKE. That was deep enough in this case. I haven't had any experience in that line.

Mr. FUCHS. I move, Mr. Chairman, that the conference give Mr. Alford a vote of thanks, not only for the assistance he has rendered in the field to some of us engineers in dynamite work, but for his great kindness in coming here and giving this very interesting talk on dynamiting.

(The motion was seconded and carried unanimously and a rising vote of thanks given Mr. Alford.)

Mr. LE PRICE. The next paper is "A plan for increasing efficiency in malaria-control projects." Mr. Komp.

A PLAN FOR INCREASING EFFICIENCY IN MALARIA CONTROL PROJECTS.

W. H. W. Komp,
Assistant Sanitary Engineer, United States Public Health Service.

We are all familiar with the cooperative plan for malaria control, whereby selected towns were to be aided in eliminating their malaria by the combined action of State boards of health, the International Health Board, and the United States Public Health Service, and then used as demonstration points, from which it was planned to extend the work to other parts of the country.

Under the cooperative plan, instructions issued to the field directors were that surveys be made during the summer and early fall where possible. It was expected that drainage work and other control measures were to begin as early as possible in the spring. The cooperative agreement has been in effect two and one-half years (November, 1921), and under its terms many towns in the Southern States have undertaken campaigns for the eradication of malaria. The success of these campaigns has been very encouraging, as malaria control has been effected in each case within the limits of economic possibility, and plans are now being made to extend the work, placing it on a broader basis, the county being the new unit proposed.

Although the work has proved so notably successful under the present method of administration, there seem to be several points in which the plan might be improved. One defect which has been apparent to all is the lack of any dependable statistics of the incidence of malaria. Without some measure of the malaria morbidity, no accurate estimate can be made of the effectiveness of the control work. Doctors' reports of the number of cases of malaria treated during the preceding year have been made the basis of comparative statistics, but it is unfortunately true that the great majority of physicians keep no record of cases treated. Even when such a record is kept, it is usually only a daybook, in which the nature of the case treated is not entered.

A second disadvantage of the present system lies in the time of making surveys, which are usually left to the end of the season, after control measures have been stopped. It is well known that estimates made during late fall and winter, after the rains have set in, may be 100 per cent too high. Entirely wrong ideas of the amount of work to be done may be obtained by making the preliminary surveys during the rainy season.

A third disadvantage, which seems to be the greatest, is that the bulk of the drainage work is done at a time when the greatest amount of water is on the ground. That this is a serious hindrance does not need to be pointed out to this assembly. The work is delayed by rain; the laborers are disinclined to work in deep water; the effectiveness of their efforts is much reduced because a shovelful of water must be moved with every shovelful of earth. Almost always, boots must be bought for them, an item of some weight when budgets are limited.

In localities where much clearing of brush and undergrowth must be done, an additional disadvantage under the present system lies in the fact that such clearing must be done over again to a large extent in the late summer if the first work was done in the early spring, the normal growing season. Mr. D. L. Van Dine, director of the Bureau of Entomology laboratory at Mound, La., who has had extensive experience in impounding waters as an antimalaria measure, strongly advises that all clearing and destroying of vegetation, especially of willows, should be done in the late summer and early fall, while the sap is still in the leaves and branches.

The proposed plan of work may commend itself, it is hoped, because it does away with the drawbacks of the present program and introduces several features which have proved their practical value in actual use. Briefly, it is proposed to take advantage of natural conditions, turning them to account rather than working against them.

Inquiry made of the United States Weather Bureau brought out the fact, which is a matter of common observation, that the winter and early spring months are the season of greatest rainfall over almost the whole of the malaria belt, while the late summer and early fall months are the time of least rainfall. Observations extending over a period of 20 years show that in the 12 Southern States in which malaria is most prevalent, from 25 to 30 per cent of the total annual rainfall occurs in the winter months—December to February, inclusive. The only States in which this is not the case are Florida, which has a unique type of rainfall—heaviest in July, August, September, and October—and Texas, where the winter precipitation is lightest. On the other hand, rainfall in the other Southern States is lightest during the autumn months, September to November, inclusive, averaging only from 15 to 20 per cent of the total.

This being the case, it would seem logical to arrange the program of work so as to take advantage of these conditions. This might easily be accomplished by doing the drainage work during the late summer and fall, when conditions are most favorable from the standpoint of local drainage and weather conditions, as well as from that of the availability of labor.

In addition to the advantages to be derived from a recasting of the malaria-control program, so that the bulk of the drainage may be done in dry weather, such a plan will permit of a more extensive use of machinery. In this connection it is suggested that the greatest forward step that any Southern State board of health could make in malaria-control progress would be the acquirement of a heavy gasoline tractor, a tile ditcher, and some form of self-propelled ditching machine to be used by its bureau of malaria control in malaria drainage operations. Such mechanical equipment could be loaded on flat cars, transported from place to place, and by intensive work the bulk of the serious malaria-drainage problems in any State disposed of in five years. A tractor is invaluable for doing heavy clearing, as it can snake out a clump of willows or a heavy log in one pull, or break up a log jam with the greatest ease. It will pull a Martin ditcher or a grading machine and go anywhere at any time. The tile ditcher will be a good investment, as many farmers will provide the tile and the labor to back fill if the tile-drainage system is laid out and the ditches dug. This is permanent drainage and has practically no upkeep cost, usually a very important item in antimalaria work. The ditching machine, in handling large projects, would do the work of a large gang at small cost and would be practically independent of labor conditions.

It may be mentioned in passing that some form of ditch-cleaning machine is a very pressing and immediate need in present-day antimalaria work. Maintenance costs must be reduced or much of the good work done in the past will be abandoned. New Jersey has solved the problem of maintaining her tremendous system of salt-marsh ditching by machinery, and it ought to be possible to devise a machine which would maintain antimalaria ditching.

One disadvantage of the proposed system is that the amount of maintenance work will necessarily be slightly greater than if the original work were done in the spring. But this is offset by the fact that less clearing of second growth would be necessary later in the season if such work were done the preceding fall.

Briefly summarized, the chief disadvantages of the present system of work are as follows:

1. A lack of dependable statistics on malaria incidence.
2. Wrong impressions gained as to the actual amount of drainage necessary because surveys are made in the late fall and winter.
3. Necessity for reclearing second-growth brush and undergrowth in late summer.
4. Delay and inefficiency caused by rainy days and by excessive amounts of standing water on the ground in spring.

The proposed plan is to make surveys in June and July, at the height of the malaria-mosquito breeding season. Made at this time they will show more nearly the actual conditions which must be controlled. At the same time arrangements could be made with the local physicians whereby their calls for malaria could be reported monthly, giving a full year's statistics before intensive control work is begun. In the late summer and fall actual drainage operations would be begun; care should be taken to inform the public that these are not designed to bring relief during the present season, but are in preparation for an intensive campaign during the following year. The following spring, not later than May 1, inspection and maintenance should be started and continued to the end of the season. A year's previous acquaintance with the region, before intensive operations are begun, will be invaluable, as allowances can be made for local peculiarities of climate as they affect the amount of drainage and other control work to be undertaken.

If engineering is to take the prominent place it should hold in county malaria work, some method must be evolved to lessen the cost of permanent drainage operations. This plan is put forward in the hope that it may decrease the cost of the work, and consequently increase the possibility of extending antimosquito measures, which, when all is said and done, is the method which gives the most permanent malaria control.

DISCUSSION.

Mr. LE PRINCE. Mr. Komp's paper on increasing efficiency of malaria-control projects is open for discussion.

The fact was mentioned that it would be advisable to start the survey in June and July. That would be advantageous in certain ways, particularly in regard to getting the assistance of the physicians, which we need and can't get along without, as we all know. It is too early, and yet it is too late. If we started a year ahead, or rather if the State board of health started a year ahead, with what we call the preliminary propaganda, I think it would assist the work very largely. It would probably be advantageous to make the surveys in August and September, when the real mosquito season is on and when the people are being very well impressed, if not by the making of surveys, at least by the mosquito. That preliminary propaganda is a matter that many are very interested in and wish everybody else would be the same. I think we are missing a good deal by not having towns coming to the State health department asking them for aid rather than for the State health department to go out looking for the place to work in.

Mr. SHAW. I would like to make one point in connection with efficiency, one concerning the distribution of oil or other larvicides.

I have had the opportunity to compare the costs of oil distribution by horse and cart with that of motor transportation in one town and to compare the cost of oil distribution from oil-barrel stands with that of motor transportation in another town. In each case the compared methods were actually in effect throughout one season. In both cases motor transportation proved to be less costly.

In Baton Rouge, La., in 1920 the cost of distributing oil by horse and cart was $3,027. This includes the variable factors—horse and cart at $2 per day, three laborers at $3 each a day, and a foreman. Motor distribution during 1921 cost $2,477. The variable factors in this case were cost of truck, truck repairs, and supplies, two laborers in place of three, and a foreman.

In Lake Charles the oil-barrel station distribution was based on experience during the war, using rates comparable with the past season. The cost was $2,050.25. During 1921 the cost of distribution by motor transportation was $1,419.65. The factors that go to make up these figures are, as in the above case, the variable factors.

No doubt motor distribution effects economies in large towns, and, offhand, I should think such would be the case for all towns of a population greater than 7,000.

Mr. Parker. Mr. Komp mentioned one of the most important factors in time saving that has yet been brought out—the time during which field work should be done. He has mentioned that the rainfall in Texas, the State in which I have been working, permits work to be done during the winter months. Should such a plan be followed, a town, or a unit of towns, could be freed of mosquito-breeding areas or placed under control by the time active mosquito production would commence, and, rather than working to control mosquitoes, the work would be of a maintenance nature to keep them controlled.

Early rains may be used to advantage, as was the case at Henderson, Tex., this year, where they were used to wash loose earth and sand into depressions by diverting roadside ditches, etc., getting dollars' worth of work for cents spent.

I consider the time when initial work is to be done a very important matter.

Mr. Frank. I have been particularly interested, Mr. Chairman and gentlemen, in Mr. Komp's paper in connection with the diagrams that are strung along the wall; and I am wondering whether, in order to increase the economy of malaria control measures, both as to primary work and maintenance, some improvement may not be accomplished by having all of us know a little more exactly what the past and present costs have been.

Will it be possible for the central office at Memphis to collate the various cost data and include them as an appendix in the back of the annual report, so that everybody could have a sort of Bible at hand all the time and compare their current work with past work? Then, if they do happen to strike some method of increased economy or efficiency, it will immediately be evident.

Mr. VAN HOVENBERG. I would like to agree with the speakers on the points they made on the value of doing work in the early spring, but want to call attention to the undesirability of doing much ditching during this time of the year. This is because of the large amount of flood water that is on the ground early in the spring that does not have to be taken care of if ditching is delayed until late May or early June. This is particularly true in east Texas, where there is an enormous amount of ground water during the early spring, and where you would probably do 50 per cent more ditching than necessary if you started that work early in the spring. This would be quite an item where a town is pressed for a few dollars.

Mr. LE PRINCE. Would you care to make any remarks, Mr. Fisher?

Mr. FISHER. I just wanted to say that in South Carolina we felt that was the thing we should do. Doctor Carter has always advocated it. So we started work in three towns since the 1st of September, and I am convinced that the work there is costing us very much less for several reasons. First, there is less water in the ground and the men will work more efficiently; second, it is a time when labor can be obtained much more readily and at a lower rate than it can in the season of the year when farmers are trying to work their crops; and, third, because of the fact that you do less unnecessary work. I think it is being done for at least 30 per cent, if not 40 per cent, less than it would cost otherwise.

Mr. LE PRINCE. Mr. Komp, will you close the discussion?

Mr. KOMP. Mr. Chairman, it should be explained that the only reason for advocating that the surveys be made in June and July is that in my territory, and also in Mr. D. L. Van Dine's experience in Mound, La., the time of maximum emergence of *quadrimaculatus* happens to be late June and July. It may be different in other parts of the country. And for that reason local conditions should be looked into before surveys are made. That is, we can't make any cast-iron rule as to when surveys should be made. It depends upon the time of maximum emergence, for the water that is on the ground at that time is the water which must be gotten rid of or treated in order to secure Anopheles control. Mr. Van Hovenberg mentioned the saving in cost possible by delaying the work until the great amount of water left from the early rains had disappeared. A good deal of water may be on the ground that it is entirely unnecessary to move, thus saving a lot of unnecessary work, for the water may not be there at the same time you are getting maximum Anopheles emergence.

Mr. LE PRINCE. The next paper is "Effective press propaganda," by Mr. Johnson.

EFFECTIVE PRESS PROPAGANDA.

E. B. Johnson,

Assistant Sanitary Engineer, Alabama State Board of Health.

In almost all lines of health work in recent years propaganda through the public press has been a much used means of publicity and education. It would seem that this use of the public press is warranted and well worth while; the public press is designed to give people the news not only of everyday occurrences but of all matters pertaining to the interests of the public or of any considerable proportion of the public. The newspapers are read by most of the people and offer an opportunity to reach by far more people than can be reached by any other one method.

By many people, however, the public press is not used as much as it should be, or, if used, is used so thoughtlessly and so ineffectively that it fails entirely to accomplish the end desired. Just because an article is "in the paper" it is not necessarily read, and it may be so worded that those who do read it get an entirely wrong idea from it. To be effective the article must be such that it is readable, interesting, and brings out the idea that it is desired to impart in a clear, forcible, and unmistakable manner.

It is to be lamented that so many public-health workers should have failed to get the most out of their press propaganda because they have failed to make their articles conform to these requirements; all too often the worker in the malaria-control end of the profession has been guilty. The usual worker in this profession is not a newspaper man; he does not know what the average man will read and what he will hurriedly skip over; he does not consider whether or not the public will get the same idea out of an article that he tries to put into it; he is for the most part a scientific man, accustomed to writing scientific articles, which the people do not like and will not read. Articles designed to educate the public should be written for the public and not for scientists.

That the health worker can overcome many of the common faults and can get the assistance of others to avoid the mistakes due to these faults is obvious. A person whose acquaintance is often sought, but whose advice is seldom asked for by the average health worker, is the editor. The average editor is greatly interested in health work; when a health worker gives him an article it is generally printed, but, unless his advice is asked, it is seldom given, and the health worker seldom asks for it. The editor knows what the public likes and what the public will read, for that is his business; if he didn't, his paper would be short lived.

The average editor is glad to advise the health worker in regard to the plan of articles, and it is generally true that where the advice is followed the articles do the work; that is, they are largely read by the public and convey the idea intended. As an example of what the editor can do, the propaganda used by one worker in Alabama this year might be mentioned.

Early in the spring this worker conceived the idea of taking many of the objections which the public so loudly and frequently voices to malaria-control work and treating them in the short-story form. The editors of four papers were interviewed, the plan talked over with them, and their advice as to form, length, language, and general plan obtained; the worker then wrote the articles, largely in accordance with the advice given by the editors. The resulting stories each took up one objection in a short, snappy manner, usually occupying about a quarter of a column. The points were brought out in the form of a discussion between two local men (as, for example, Mr. Jones, the banker, and Mr. Short, the sheriff), one of whom didn't like the health officer, didn't do as he advised, and did have mosquitoes, while the other, because he had followed the health officer's advice, knew exactly what the matter was, showed it to his friend, and pointed out that if the health officer's advice had not been laughed at Johnnie wouldn't be having malarial fever. These articles aroused a great deal of comment and led to a number of personal conferences, as a result of which some very nice malaria-control work was done.

The editor is useful in other ways. He is usually an influential citizen, whose opinion is much sought after and carries a great weight. An occasional article written by him helps tremendously. In some places in Alabama the editor has come in very handy when a snag has been struck on some important project. After his friendship was gained the editor was taken to the project, Anopheles larvæ and adults caught and their rôle in spreading malaria explained, and then the life history of the mosquito and the way to break into that life history and control the mosquito in this particular place carefully pointed out. The result has been a "red hot" article, written by the editor, followed by a wave of favorable popular sentiment, and the project has been completed.

In writing articles the health worker must forget, if possible, that he is a scientist, and must write simply and in language which the average man can understand, and must avoid scientific terms or language. A scientific article will not be read by more than 10 per cent of the people, and 70 per cent of those that do read it will not understand it or will even get an entirely wrong idea from it. The malaria worker may be a scientist, but what he wants to tell the public is a plain, straight, matter-of-fact truth, and he should tell just that kind of a truth in just the same kind of language.

A common fault is the "jumbled-up" article; one that tries to convey a number of big, central ideas in the short space of one article. To throw a jumbled-up mass of facts in the face of the public in this manner has very little effect, unless it be to give the public the impression that the writer is a dreamer, full of wild, impractical ideas. If through an article one big, central idea can be firmly fixed in the minds of the public, that article is well worth while. The best way to write such an article is to have but one big, central idea in it, and to hammer home that one idea good and hard.

The public likes interesting articles, and it likes them short and snappy. One big, central idea can usually be driven home in a quarter of a column, or at most in less than half a column. To spread it out over a longer space means that two essential qualities, brevity and snap, will be lost, it will be found that the interest of many potential readers will be lost along with those two qualities.

In a great number of articles where the conversation of some person occurs, that conversation is stilted, and such as would never be used in ordinary life. The advice given by the editors for the articles in Alabama already mentioned was: "Humanize your characters; cut out stilted talk that will merely make the public think what a rotten writer you are; have your characters talk naturally, just as they would in ordinary, everyday life." Their position is logical; the public must not get the idea that the writer is a queer person, something of a "nut," who does not think or write like an ordinary man.

The big result of press propaganda is not to get work done by itself; it is to get people interested so that personal contact with the people will find them interested and willing to listen, learn, and act. Unless, therefore, it is followed up by the personal man-to-man method, it loses most of its effectiveness. The importance of the follow-up work is not appreciated by a large number of health workers, who expect a newspaper article, alone and unaided, to effect a miracle with the people. It seldom does effect a miracle, but usually, unless it is followed up by close personal contact with the people, it is of very little value, and results merely in a little sporadic interest which does not culminate in action, soon dies away, and renders the public more apathetic than ever.

To be effective press propaganda, therefore, an article must convey but one big, central idea, in a thorough but short and snappy man-

ner. The use of stilted or scientific language must be avoided; the language must be such as the public is used to. The friendship and advice of newspaper editors should be sought and used. Finally, the health worker must follow up his articles by personal man-to-man work among his public if his press propaganda is to do the work he wants it to do.

DISCUSSION.

Mr. SHAW. Mr. Johnson certainly has touched the vital points of publicity. I can emphasize these important factors by admitting my own guilt in the violation of them. I have consistently adhered to descriptive articles of the work, facts about mosquito life, etc., which were much in the tone of a scientific article, or at least with introductory subject which would attract the attention of only those especially interested. I fully realized I did not know how to write newspaper articles, but it never occurred to me, until I read Mr. Johnson's paper, that much valuable help might be secured from the editor. I have felt that since the editor knew nothing about malaria and its control he could be of no assistance in presenting the matter to the public. The fact is, the editor knows what attracts the public—he knows human interest, and would suggest "human interest stories" rather than articles filled with dry scientific facts.

It appears to me important to bear in mind the fact that the public becomes interested when its curiosity is aroused. If the heading or introductory sentence causes the reader to wonder—why or what—he is likely to read the entire article to find out. A thing to guard against is misinforming the public. Some reporters are inclined to misrepresent facts or to make incorrect statements as a result of not having taken sufficient notes in an interview. I have had experiences that prove the point in mind. In reporting a council meeting, the completion of which he had not heard, a reporter heads his article "House Screening Ordinance Passed," and inferred throughout that houses would have to be screened. This caused a great commotion in the poorer districts. Tenants besieged owners and owners were much worried until they were correctly informed. Another example was an editorial entitled "Making a Mosquitoless City Mosquitoless." The possibility of creating such a false impression is obvious. An important factor is getting publicity from the local people, expressions of opinions by people or organizations that are real leaders. The populace will fall in line with prominent local opinion more quickly than they will adopt your own. Articles of value along this line were as follows: One written by a reporter after he had traversed the territory alone to compare existing drainage conditions with those of the previous year, when he was a mail carrier; a report of a trip of inspection of the mayor and commissioners, health officer and members of the board of health; report of a press representative who also made the trip; a report of our interview with a former commissioner, who admitted that he did not believe the mosquito theory when the work was started, but that he had been shown. And, finally, at the close of the campaign, there were published resolutions of the various civic organizations commenting favorably on the work and urging its continuance. Their opinion was solicited, for or against, and I refused to attend the meetings.

An item of interest in the Lake Charles campaign was the publication of a city budget in which there appeared a special item for malaria control. Mr. Le Prince complimented the mayor on this fact and stated that it was probably the first time in history that there had appeared in the public press a budget containing a special item for malaria control. This letter was published and brought forth a very strong editorial on the subject.

Another impressive factor is reports of the prevalence of mosquitoes in other localities. I have a case in mind which carried considerable weight. The health officer visited Chicago and on his return an interview was published. It was entitled "Mosquitoes Chew Chicago People." The local people were impressed by comparison.

Mr. **Frank**. I want to just briefly comment on a rather humorous aspect of the publicity problem. If you first make the friendly acquaintance of the editors and then later give the reporters this impression they will be at you all the time. They were in Dallas. For two full years I tried deliberately to give them the impression I was trying to hide something. And as a result I have two great big scrapbooks packed full of publicity.

Mr. **Stromquist**. I wish to emphasize Mr. Johnson's suggestion to make newspaper articles readable. We have had no definite publicity plan in connection with the mosquito-control work in Memphis, but from time to time newspaper articles would appear about it and these would always be followed by a number of complaints about mosquitoes. In many instances the complainant would say that he did not know such work was being done until he read about it in the paper. One lady said, "I read that piece in the paper and of course it is probably just some fellow down in the city hall who wants publicity, but if there is really anything to it I would like to tell about the mosquitoes in our house." As an instance of a readable article, in a drug store one night I heard the druggist taking down an order over the telephone which included a bottle of Sweet Dreams, the local favorite mosquito remedy. I asked him where the order came from and the next day I sent the inspector out there. The lady was very much surprised when he stated his errand and said she had made no complaint, and he surprised her still more when he said no complaint had been made but that she had been buying Sweet Dreams. He located a breeding place next door, where the people had gone out of town on their vacation and had left a tub and pail of water on the back porch. The mayor heard of this, and gave the story to a reporter and the following day we had some more complaints.

Mr. Le Prince. Is there any further discussion?

Mr. Komp. Coming here on the train, Doctor Barber gave me an article by the former editor of the Independent, Mr. E. E. Slosson, to read. It is so appropriate that it ought to go into the minutes. Some parts may be omitted, but I can give the gist of it. [Reading:]

The article is entitled "Dont's for Would-be Writers of Scientific Articles for the Public Press." It begins: "Don't overestimate the reader's knowledge and don't underestimate the reader's intelligence. He may not know as much as you about this particular thing—let's hope not, anyway—but otherwise he may be as bright as you are—let's hope so, anyway.

"Don't think that because a thing is old to you it is known to the public. Many of your readers are still living in the nineteenth century; some of them are in the eighteenth.

"Don't imagine that the readers of a popular article are obliged to pretend to pay attention to you, no matter how dull you may be. 'First, catch your reader,' is the rule of successful writing.

"Don't leave out the human interest. Your reader is a human being even if you are only a scientist.

"Don't forget that your reader is interrupting you every 10 lines to ask, 'Why?' 'What for?' or 'Well, what of it?' and if you don't answer his tacit questions he will soon stop reading.

"Don't think that you can make your topic more attractive by decking it out with fairy lore or baby talk or irrelevant jokes or extravagant language. Bring out its real and intrinsic interest as forcibly as you can. Set off the red fire if you like, but be sure it lights up the subject instead of drawing away the attention from it.

"Don't say 'this discovery is interesting' unless you can prove it, and if you can prove it, you don't have to say it.

"Don't suppose you must give bibliographical references to all the literature of the subject but don't fail to give a clue by which the interested reader can get on its trail.

"Don't fail to put your best foot forward. Otherwise you won't have a chance to use the other foot. Note the construction of the news story in any first-class paper. It is built up on the same logical system as the symphony or opera. The opening paragraph gives in succinct fashion the main point of interest, the gist of the story, just as the first movement or overture of a musical composition expresses the theme or motif." There is considerable more of the article, but the foregoing paragraphs are the most relevant to our subject.

Doctor GRIFFITTS. I am just going to take a minute. I remember a few years ago when I was in the Illinois State Health Department that a member of the Chicago Board of Health said he could produce an epidemic of flu, or influenza (an epidemic of reports, of course), in the city of Chicago by a small squib in the city newspapers. I don't think that we increase mosquitoes by publicity; I do know this, that unless we are very careful in doing this thing we call "publicity"—it is something that has been overworked, like "efficiency"—that we may do more harm than good. Be very careful. It is better to say what "has been done" than "what will be done." I know of one town that had been heavily struck by malaria and a mill owner had lost a quarter or more of his help in that village the year before. The newspaper told the story, and told it straight, but it served only the purpose of increasing the mill's difficulty of getting labor. To keep the mill from withdrawing its proffered support of several hundred dollars, I had to assure the superintendent that the only publicity given would be that malaria "has been cleaned up."

Just one word calling attention to the type of articles that you write. A newspaper in a large city informs me that the press is "fed up" on the usual mosquito story. They told me that they wouldn't accept an article on the mosquito subject unless it was in the form of a feature story bringing home local affairs. I wrote an article. Some of you have copies of it—rather a few suggestions in a rather unusual way. After discussing malaria in general, and historically especially, I put in bold type:

WHAT THE CITY CAN DO,
WHAT THE CITY COUNCIL CAN DO,
WHAT THE CHAMBER OF COMMERCE CAN DO,
WHAT THE PHYSICIANS CAN DO,
WHAT THE JUDGE CAN DO,
WHAT THE LAWYER CAN DO,
WHAT THE PREACHER CAN DO,

all the way down the line. Every individual in that community will read it to see what each individual has to do. It concludes by what these can do:

RICH MAN.
POOR MAN.
BEGGAR MAN.
THIEF.

The rich man can better care for his tenants; the poor man can screen his house with the money he has been spending for quinine, and "chill tonics," and have more time to work and better health. What the beggar man can do: Can go to work for the board of health, digging ditches and spraying oil. What the thief can do is to steal away all the misinformation in the community about malaria coming from weeds on vacant lots, the old swimming pool, decaying vegetation, and all the rest of the "rot," escape, leaving behind "No mosquitoes, no malaria."

Mr. Le Prince. The next paper is by Mr. Magoon.

EDUCATIONAL WORK, EXHIBITS FOR SCHOOLS.

E. H. MAGOON,

Sanitary Engineer, International Health Board.

Educators are seeking to make the system of instruction in the schools both practical and efficient. Superintendents, principals, and teachers in districts where malaria is prevalent recognize the fact that the knowledge concerning mosquitoes and malaria control should be taught in the schools. The problem is presentation of the subject in such a manner that the pupils will comprehend and retain the desired information. The instruction given by lecture often fails to produce the desired impression, because the subject is not closely related to any existing knowledge or impression of the hearer that he may be able to interpret its meaning.

The subject of mosquitoes and malaria is sufficiently technical to make its manner of presentation of importance. In a lecture it is often necessary to tell of the popular information or misinformation on the subject and connect this with the talk. One doctor carefully explained how malaria was caused by parasites which were spread by mosquitoes. At the end of his talk he asked a boy to explain how malaria was spread. The boy replied that mosquitoes go out into the swamps and drink dirty water and come back and bite people and give them this poison. I mention this because it may lead us to have more modest expectations of being able to make revolutionary changes in existing conceptions of the problem as a result of one lecture. Much instruction on the subject should not be attempted with younger students. Visual presentation of the subject makes it possible to successfully present the subject to younger people. Mr. Ernest A. Dench writes in the August, 1916, issue of American City that the most effective medium in a health campaign is moving-picture presentation of the subject. He recommends the films, "The Mosquito" and "The War on the Mosquito." He also said: "You can not interest children in health and sanitation by the lecture or the literature routes so they will readily understand what you are driving at." The Literary Digest of August 7, 1920, quotes an article by Mr. Jerome Lachenbruch, entitled "The Silent Teacher," contributed to the Scientific American. The writer asserts that subjects formerly taught in colleges may now be understood by children of 10, and the man in the street may fill in his education by seeing the animated technical drawing in the moving-picture theater.

Methods used by the writer in educational campaigns are explained, beginning first with the primary grades.

In the first and second grades the pupils are shown rafts of Culex eggs (if practicable with some hatching), bottles of Culex wrigglers, and sometimes a jar of wrigglers and pupæ with many mosquitoes already emerged. The pupils are also shown a bowl of live Gambusia minnows. The local inspector can assist the teacher in showing the eggs, wrigglers, adult mosquitoes, and fish. He can sometimes arrange with the teacher to have the children bring jars on a specified date to obtain pairs of Gambusia for cisterns, wells, and watering troughs. Simple explanations concerning the exhibits may be completed within 20 minutes.

More information is given to the grades above the primary division. Instruction to the grades from the third to the seventh, inclusive, is centered about an exhibit and a blackboard talk. Figure 5 shows an outline on a blackboard. It both explains the labels on the exhibits and shows the students distinguishing features to look for. The outline is often copied at once by the teacher, who not infrequently writes "Do not erase" next to the outline after the blackboard lecture is completed. More information may well be placed upon the board for the advanced pupils. The special place given *Aedes calopus* may be omitted where this mosquito is not common. The blackboard discussion usually takes half of the class period, and the remainder of the time is given to examination of the live specimens in the exhibit and to discussion of places where they may be found and what control measures should be used to prevent their breeding. The Gambusia minnows may be fed live wrigglers in front of the class. It causes some confusion and generally there is insufficient time to have the entire class divide into groups and each group witness the capture of at least one wriggler.

All the information given the students in the grammar grades is frequently needed in the educational work in the high school. In addition to the blackboard lecture and exhibit, a second period is required for a discussion of the cause of malaria and methods of controlling mosquito breeding. Much of this has to be done by the lecture method. Frequently the subjects of the lecture are taken up in the same order as that given in a printed outline which is distributed after preliminary remarks concerning the control of such diseases as typhus fever, plague, yellow fever, hookworm, and malaria. The printed outline, entitled "Data on Conveyance and Prevention of Malaria," serves as notes on the lecture, with each point sufficiently explained to make it of value to people who have not heard the discussion of the different topics. A total of 15,000 of these outlines have been printed. Many of these have been distributed in this way to high-school classes, teachers institutes, civic organizations, and

Fig. 6.—General science class. Dipping larvæ from a stream and capturing Anopheles imagoes resting on the banks.

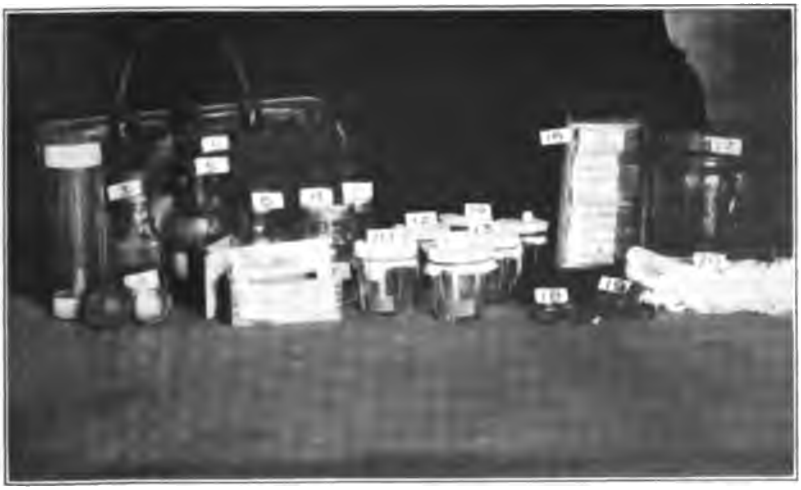


Fig. 7.—An exhibit which may be recommended for use in a high school. The material displayed may all be carried in the 13-inch traveling bag marked No. 1.

prospective teachers in college and normal classes. Classes in general science and in biology have laboratory periods which permit field trips for collection of Anopheles larvæ and a study of mosquito breeding. Figure 6 shows a general science class from Palestine, Tex., high school, dipping larvæ (chiefly *A. pseudopunctipennis*) from the stream and capturing Anopheles imagoes resting on the banks. The teacher and city sanitary inspector are with the students, who were taken to places where it was known that the search would be successful.

The United States Public Health Service publication, entitled "Malaria; Lessons on its Cause and Prevention," is a good supplement to the brief discussion commonly given in the textbooks on general science. Science teachers who are interested in the subject of mosquitoes and malaria seek copies of this publication as textbooks for their classes. The subject matter is well arranged with good illustrations, which are helpful in laboratory work to identify mosquitoes. The publication was prepared for use in schools by Dr. H. R. Carter, Assistant Surgeon General, of the United States Public Health Service.

An important addition to the educational campaign in the schools may often be the visual presentation of the mosquito problem by means of moving pictures. The two films "The war on the Mosquito" and "Stung by Amos Quito" may be run in one-half hour. In towns and small cities school auditoriums are rarely equipped with moving-picture machines. This has scarcely hindered the work because theater managers usually are willing to show the films during school hours at their theaters. The school children march by classes to the theater and enter at appointed times. Physicians, civic organizations, and the public have sometimes been given invitations to these free exhibitions of the two mosquito films. The film "Stung by Amos Quito" is especially prepared for interesting communities in malaria-control work. At the time when moving-picture presentation of the mosquito-malaria problem is in progress with the schools and civic organizations, the films should be loaned to theaters for use in connection with their programs. This will largely increase the number of people who will see the mosquito films. In an east Texas district, the writer had the use of the two mosquito films owned by the Texas State Board of Health. About 50,000 people saw at least one of these films during five weeks' time. These films are judged to be of great value in creating interest on the subject of malaria control.

The success of educational measures in the schools is largely influenced by the interest the teachers have in the problem. Professors of sociology and hygiene in colleges and normal schools should be furnished data concerning the progress of malaria-control measures, and given help in the presentation of the problem to prospective teachers. The writer's experience has been that teachers of biology in these schools are always glad to secure material for their laboratory work. They also wish assistance from health agencies in presenting the subjects of malaria control and hookworm control. Much the same exhibit should be displayed at teachers' institutes as that before high schools.

Important educational work on the subject of mosquitoes and malaria may be done by health officers, physicians, clergymen, Red Cross nurses, home demonstration agents, county engineers, county agricultural agents, and, in fact, all welfare workers. It has been the writer's practice to strive to familiarize health officers and welfare workers with the field work in connection with finding Anopheles and the control of mosquito-breeding places.

Teachers and others interested in preparing exhibits of mosquitoes frequently ask questions about keeping the adult specimens alive and at the same time having them in suitable containers for display. The following method has been found satisfactory: One or two adult mosquitoes are kept in wide-mouth containers. These glasses are covered with cheesecloth, which is held in place by a rubber band. On top of the cheesecloth should be kept a piece of banana, split date, or other sweet fruit. This should be moistened several times daily. When the weather is cool it is practicable to keep the Anopheles Culex (excluding psorophora), and *Aedes calopus* mosquitoes alive nearly one month. They must be protected from ants, which may quickly destroy an exhibit. The jars containing Anopheles larvæ, as well as the fish jar, should have the water freshened at intervals if it is not supplied with green algæ. A satisfactory exhibit need not be bulky. Figure 7 gives a picture of an exhibit which may be recommended for use in a high school. The material displayed may all be carried in the 13-inch traveling bag marked No. 1. Adjacent to it is a celluloid mosquito-collecting device useful in capturing live mosquitoes. Scissors, rubber bands, and cheesecloth are marked 18, 19, and 20, respectively. Two magnifying glasses, designated 4, are useful. The suggested specimens for these containers are as follows: 3, Culex egg rafts; 5, Culex larvæ; 6, Culex pupæ; 7, mounted Anopheles wings; 8, Anopheles larvæ and pupæ; 9, Anopheles larvæ; 10, Anopheles female; 11, Anopheles male; 12, Culex female; 13, Culex male and female; 14, *Aedes calopus* male; 15, *Aedes calopus* male and female; 16, mounted specimens of mosquitoes; 17, Gambusia minnows in pint jar.

Mayors and city councils sometimes appeal to the schools for their help in spreading information designed to secure control of mosquito breeding. The city officials may appeal to women's civic clubs and secure their pledge to assist with educational work among householders. A woman's civic organization at Crockett, Tex., assured the city council that they would care for the educational program of the cooperative antimalaria demonstration if the council would look after the inspection and field work. The Red Cross chapter and the civic club furnished about 40 women, who began the study of the mosquito malaria problem. Lectures with exhibits were given, literature distributed; mosquito problems were discussed and much opportunity given for answering questions. A week of class work was concluded with free exhibitions of mosquito films owned by the United States Public Health Service. This was arranged for by the civic club leaders for the benefit of both the white and colored householders. Then the ladies made a list of the 700 householders in the town and subdivided the work to local chairmen. Selected literature was distributed, and each person on the educational canvass made a report on each home which had received the antimalaria information. This report was in the form of a census card, which was used to organize the campaign of education among the householders. The questions concerning mosquito-breeding places gave the person making the canvass a good opportunity to explain her instruction concerning control measures. The town was made almost a unit in favor of mosquito-control work as a result of the campaign of education. The city marshal, who was made sanitary inspector, secured excellent cooperation from the householders, which resulted in effective control of Culex and Anopheles breeding. The antimalaria measures have met with universal approval. All the credit for the successful educational work should not be given to the civic club. The county and city health officer and other practicing physicians went out on field trips to find Anopheles. The schools also endeavored to instruct every pupil concerning breeding places for mosquitoes.

SUMMARY.

1. In endeavors to teach the subject of mosquitoes and malaria much use should be made of methods that will help the pupils to visualize the subject.
2. Exhibits of the different stages of the live mosquitoes may profitably be used in lecture work before public schools, normal and college classes, teachers' institutes, civic organizations, and city councils.
3. By means of sketches on the blackboard instruction may be made clearer and the exhibit of live specimens made easier to understand.
4. A printed outline giving definite information which it may be desired to establish in a lecture may be distributed to advantage to people listening to a talk on the subject.

5. Health agencies should arrange for teachers, engineers, doctors, and all welfare workers to receive malaria-control information, together with field practice in finding Anopheles. They should be given sufficient information to enable them to advise on local control problems.

6. More films should be prepared for use in teaching the subject of malaria control. Attention should be given to have these films both interesting and scientifically accurate.

7. Educational campaigns in schools and other places tend to give the general public information about mosquitoes and malaria. The more general the information on this subject, the greater the local efforts that may be expected toward controlling this disease.

[Census card used in an educational canvass.]

CROCKETT, HOUSTON COUNTY, TEX.

Index Map No. ——.

ANTIMALARIA CAMPAIGN CENSUS CARD.

Head of house ---------------------- Location of house ----------------------
Owner of house -------------------- Address of owner ----------------------
Number of people living in house: White -------------- Colored --------------
Type of house: Dwelling ------- store ------- servant house ------- or -------
Is there on the premises city water? ------- Underground cistern? --------------
Wooden cistern? ------- Metal cistern? ------- Well? ------- Cesspool? -------
Bath drain without sewer connection? --------- Watering trough? ---------
Roof gutters? ------- Rain barrels? ------- Stock pond? ------- Mention other possible mosquito-breeding places --
Mention standing water, wells, cisterns, etc., on near-by vacant lots ------
----
Remarks: --

Does resident wish top minnows (*Gambusia affinis*) for control of mosquito breeding in well or underground cistern? ------------------------------------
Has resident been told of antimosquito ordinance? ---------------------------
Literature given? ----------------- Name of person interviewed -----------------
Signed ---------------------------------- Date --------------------------- 1921.

Mr. LE PRINCE. The discussion of this subject will be continued to-morrow. The meeting is now adjourned.

Morning Session, November 16, 1921.

The meeting was called to order by Mr. Le Prince at 9 o'clock a. m.

Mr. LE PRINCE. The meeting is called to order. I understand that Doctor Fricks desires all of us to look over the malaria exhibit and make suggestions for the coming year's exhibits.

The first paper this morning will be "Methods of malaria control used in Talladega County, Ala." Dr. J. H. Hill.

METHODS OF MALARIA CONTROL USED IN TALLADEGA COUNTY, ALA.

Dr. J. H. Hill,

Health Officer, Talladega County, Ala.

One of the first and most essential elements in malaria-control work consists of laying the foundation by bringing the people squarely up to the realization of the need of it. Till this is done the work will generally be done in a half-hearted, sporadic manner, effectively for a few days, and then left undone. In this way it is brought into disrepute. A method we have found pretty effective in arousing a demand for the work is to go before city councils, civic organizations, and business women's clubs, setting forth in a clear-cut way the economic loss to the individual and to the South as a whole as a result of the prevalence of malaria. Frequently it is a matter of interest to many of the members to give a lecture easily understood by a layman on the causation and mode of transmission of malaria.

In other instances we have been able to get the public aroused by catching the different species of mosquitoes and larvæ and putting them on exhibit, labeling the different varieties and placing placards alongside the specimens stating where the malaria-carrying types were found breeding.

In one town we were able to secure the cooperation of the city officials for the first time in the history of the town by going to the public schools and lecturing to the higher grades on mosquitoes, giving out a primer on malaria to each student, assigning it to the children for study. On the first morning of April these same grades, with their teacher, were "paraded" through the business part of town in a body and taken to breeding places and a practical demonstration given in field identification and methods of mosquito control. In the same town the editor of the local paper was taken to the local breeding places and shown how prolific was the breeding and the possibilities of an outbreak of malaria as a result thereof.

After sufficient interest is aroused to secure an appropriation for the support of the work, a local man is employed and the health officer goes with him and gives him practical lessons in locating breeding places and the most satisfactory methods for their eradication.

For the first few weeks that the work is carried on the health officer or some other person acquainted with malaria-control measures visits the local man once a week, checks up on his efforts, and shows him how to overcome whatever obstacles he may have encountered.

The actual methods of malaria control could be divided into the following activities:

(*a*) Efforts directed toward the destruction or eradication of mosquito-breeding places.

(*b*) Destruction of larvæ.

(*c*) Protection of populace against the mosquito.

(*d*) Sterilization of carriers and cases.

Wherever it was possible, we secured draining of marshes and ponds as the most permanent and satisfactory method. The original outlay was necessarily greater, but the permanence of the work justified the expenditure.

In several places we found it necessary to have the ditches and ditch banks cleaned and the walls of the ditch reshaped so as to make them slope down in a V shape rather than perpendicular, before any other method of control could be used effectively. In one notoriously bad breeding place this alone sufficed.

While realizing that the malarial types of mosquito rarely breed in tin cans and other artificial containers, yet we concluded that the populace was entitled to protection against the pestiferous types, and accordingly instituted, wherever possible, clean-up campaigns in towns and villages and secured the disposal of such containers.

The cutting of underbrush and the mowing down of weeds and grasses, thus destroying resting places for the adults and drying up little pools that would otherwise have served as breeding places, proved very helpful. In this connection we accidentally discovered that the cheapest of all methods of getting rid of the undergrowth was the pasturing of goats on the land. The economy of using goats to clean up cut-over lands has been recognized for several years by progressive farmers. Another advantage in his favor is the fact that he is always on the job.

On unpolluted streams and pools, especially the former, the use of oil in the form of oil-soaked sawdust applied carefully at intervals of a few yards to the main stream and to all little sheltered coves once a week was found to be both economical and effective.

On dirty, filthy pools and streams polluted with laundry water and sewage the spray can with kerosene or a mixture of kerosene 4 parts to 1 part cresol dip was the only means found to be effective.

The top minnow, *Gambusia affinis*, was used pretty extensively in wells, cisterns, stock ponds, log ponds, reservoirs, and lakes. In our efforts at mosquito control we encountered three rather unique problems. The Coosa River Reservoir above Dam 5 was found to be a very prolific Anopheles-breeding place, with a few cases of active malaria in that vicinity. It was obviously out of the question to hope for immediate results from the limited number of fish that could be introduced into such a large area. Fish were, however, placed in little lakes that overflow into this reservoir, with the idea that at some time in the future they will be numerous enough to cope with the situation.

The residents were advised to screen their houses effectively and to take prophylactic doses of quinine, and efforts were made to sterilize the active cases.

Another unique problem consisted of a large log pond embracing about 3 to 5 acres and filled with saw logs. A survey showed most prolific breeding of Anopheles, both along the margins of the lake, among the floatage, and alongside the surface logs.

Several hundred Gambusia were introduced into this pond, the edges cleaned, and the operators at the mill instructed to keep the bark and floatage removed so as to give the fish a better chance to catch the larvæ. It remains to be seen how effective these measures will be, as the fish are not yet numerous enough to take care of the situation.

Probably the most difficult problem and one fraught with the greatest potentialities, because of its location on the border of a town of about 7,000 inhabitants, consisted of an artificial lake with an area of about 6 acres, the surface of which is carpeted thickly with a growth of two kinds of grass. Both of these grasses grow luxuriously, and together they form a covering dense enough to hold up the weight of a bullfrog. One of these grasses is tender and easily dislodged from the bottom of the lake, but the other, which is the predominant type, is as tough as Bermuda grass and so well anchored that a man can not pull an iron-tooth rake through it. This lake is teeming with Gambusia, but they are ineffective as a result of this floating grass mat except in the clean areas. Oiling as a control measure is obviously impractical. The lake is fed by two or three springs and confined by a combined wood and concrete dam. An effort was made to lower the lake and thereby cause the grass to attach itself to the bottom and then quickly raise the water so as to bring the surface above the grass and give the Gambusia a chance to get in their work. But the inflow of water during the past dry summer was not sufficiently rapid to give the desired rapid fluctuation, and while the measure was helpful it was far from effective.

Screening is being advocated by the health officer at all health meetings, but many landlords are not yet convinced of the economic value of keeping their tenants healthful.

The standard quinine treatment, as outlined by the National Committee on Malaria, has been introduced in a number of towns and its use popularized among the laity and physicians. Some are prescribing it in the original packages just as it comes from the manufacturer, while others prefer to prescribe quinine as before, except that they now prescribe a hundred or more capsules and advise its use for a number of weeks, whereas they formerly prescribed it in smaller quantities and had it used for much shorter periods of time.

There are two outstanding and encouraging features of this work. One is the fact that in communities and towns where it has been done in preceding summers not only are they keeping up the work, but adjoining communities and towns are taking it up. In other words, the sphere of activities is widening. The second and most valuable feature is the fact that after about two summers these communities do the work for themselves, hardly requiring any attention from the health officer.

In closing I wish to acknowledge my indebtedness for valuable help and advice in this work to E. B. Johnson, assistant sanitary engineer of Alabama; Dr. C. P. Coogle, of the United States Public Health Service; and J. A. Le Prince, senior sanitary engineer, United States Public Health Service.

DISCUSSION.

Mr. LE PRINCE. Mr. Johnson will open the discussion.

Mr. JOHNSON. Mr. Chairman and gentlemen, I think the most important feature of Doctor Hill's work is Doctor Hill himself. I am very much disappointed that Doctor Hill couldn't come over here and see you and you see him. Doctor Hill is a country doctor; and like a lot of those countrymen, he is one of the very best men that we have. He didn't know when he came on the work last December about malaria-control work, but he went to work and got started, and he has put things over in Talladega County that are perfectly astounding. He has got the people of that county right in back of him. All he has to do is to go out and suggest that a thing be done for the town and the thing is done for the town in regard to malaria-control work. He is on the job himself and a full-time sanitary inspector also, and one or the other of them visits every town and every rural project in that county. When he learns that Anopheles breeding is taking place he goes down and thoroughly examines the place and then inspects all of the outbuildings and under the houses in the vicinity. If he finds any breeding, he doesn't just go up and tell the mayor, or the man who is doing the work, about it; he goes up and calls out these men and takes them down and very carefully maneuvers so that all of them take a dipper and dip up some wrigglers. If you want good results in your town, let the mayor go down and handle the dipper himself and find some wrigglers. It is the most interesting method that I know of, and gives results. Maneuver around so you will get them to handle the dipper and let them find the wrigglers.

Another feature of Doctor Hill's work has been his work among the children. He went into one town he had never been able to get a foothold in before. That is the town Sylacauga. The first work we were able to get them to do was done because we took the mayor out and showed him mosquito wrigglers. And now that town has as good malaria control as any town in the State. They got the idea of sanitation—not of mosquito control, but of sanitation—because we took them up there and showed them how the wrigglers could be controlled. We took the children out and showed them how the wrigglers could be controlled. In about 90 per cent of the breeding places the man doing the work will be out some day and a child will run up to him and say: "You know that pool over at such and such a place; it is full of wrigglers this morning." I think I have been in that town myself perhaps twenty-five times this year, and I don't believe I found more than half-grown wrigglers, and very few of them. Mr. Le Prince has been over one time, and I believe after a very exhaustive search he found two adult Anopheles.

I want to say that the work is not the result of my efforts; it is not the result of the work of Doctor Coogle. It is not the result of Mr. Le Prince; it is the result of one man's effort, and that man is the county health officer of Talladega.

Mr. **Le Prince.** The subject is open for discussion.

Doctor **Coogle.** It was my good fortune to be associated with Doctor Hill during the months of May and June of this year. I not only know of him as a good health officer, but I know of his magnetic influence. He has a way of mixing among the people and he gets them interested in health work.

I wish to add to Mr. Johnson's very thorough discussion a description of a beautiful piece of health work accomplished by Doctor Hill in the village of Bon Air, Ala. Bon Air is a small village of about a hundred families; it is owned by a cotton mill company for its employees. Sanitation had been greatly neglected, drainage was bad, frequently a creek overflowed the lower half of the village, the contents of the surface privies was washed around accordingly. The water supply was from a spring which at one time showed *B. coli.* In the presence of typhoid fever in the village repeated efforts on the part of the former health department only brought forth promises and no actual corrective measures.

Doctor Hill found if he could get the people interested in mosquito eradication he might succeed in getting other sanitary work done. This he did. He succeeded in getting 45 sanitary privies built in that village, also a general clean up. The success was attributed to teaching the people first to eradicate their mosquitoes, then step by step better sanitation.

To interest people in eradicating mosquitoes is a drawing card to better sanitation; this plus a magnetic personality, similar to that of Doctor Hill's, gets results.

Mr. Le Prince. I want to call attention to one of Doctor Hill's methods which I happened to notice. He wanted to convince a mill operator that it was feasible to control his pond properly, and the operator thought that he couldn't do any work there at all. He did not tell the mill operator that he was wrong, but let him discover his mistake. The mill operator said fish couldn't live in the log pond, but Doctor Hill put a cage of fish into the pond near the office door, and every time the man came through the door he saw that the fish were there and did not die.

The next paper will be "Methods of malaria control on the Central of Georgia Railway," by Mr. H. N. Old.

MALARIA CONTROL ON THE CENTRAL OF GEORGIA RAILWAY.

H. N. Old,

Assistant Sanitary Engineer, United States Public Health Service.

It has frequently been said that nothing succeeds like success. The enviable success that has attended the efforts of Mr. Van Hovenberg on the Cotton Belt Railway Lines has probably influenced the Central of Georgia Railway officials to inaugurate malaria-control measures on that system.

Upon request of the chief surgeon in 1919, an engineer of the service was detailed to make a survey of malaria conditions on the Central Railroad and submit recommendations. The survey was partly completed when this man's services were needed on plague work, so that the program was interrupted from July until November of last year, at which time the writer assumed the assignment.

While drainage aiming at mosquito control is the measure to be most desired, it is not practical under all circumstances. Considerable Central of Georgia mileage traverses parts of Georgia and Alabama that will require millions of dollars to properly drain, so that even an unlimited allowance for right-of-way drainage would not materially remedy the railroad malaria problem; therefore with the exception of cooperation with towns, counties, or individual landowners this most permanent and desirable malaria-control measure could not be used to advantage. But whenever there is the assurance that the land for a distance of three-quarters of a mile on each side of the track will be properly drained, the company will be only too willing to assist to the full extent of their power in the elimination or control of Anopheles-breeding places on their property.

As drainage could not be used, quinine prophylaxis and screening were given consideration, but the former was eliminated, due to the fact that not sufficient personnel was available to property oversee and check up on the administration of the quinine. Therefore control measures deemed most feasible at this time were screening and education among the roadway forces, particularly as it was found that this class furnished the bulk of malaria cases on the road.

By reason of the survey made early in 1920 it was found that on a stretch of the road 175 miles in length, between Smithville, Ga., and

Florala, Ala., on the southwestern division, the malaria rate was exceedingly high. On this branch 19 section crews were canvassed and 44 per cent infection found, not by blood examination but by cases reported from clinical diagnosis, and 40 per cent among five bridge and extra gangs on this same branch.

It was decided to concentrate efforts chiefly on this branch, and section houses and camp cars were carefully examined as to mosquito-proofing possibilities. Some of the cars were condemned as unfit for use, and 14 were entirely screened with No. 16 mesh galvanized wire at an average cost of $57.25 per car. Numerous other cars were recommended for renewal of torn or defective screens, plugging of holes in the floor, walls, or roof, and similar small repairs. During the season of 1920 there were screened 69 camp cars, many of which were only minor repairs, but were recorded as screened.

During this year there have been 116 section houses screened at a cost of $2,365.12, or an average of $20.40 each. Most of these were located on the Florala branch, of which former mention has been made.

It is felt that the efforts and funds that have been expended on this section of the southwestern division were of immense value not only as an investment but as a demonstration of what may be accomplished.

By means of a recent canvass covering the same section crews and camp car outfits as were canvassed in 1919, a reduction in prevalence is noted from the rate of 43.9 per cent of that year to 6.3 per cent during this year, only 14 cases and 101 actual days lost in a total of 222 men worked during the malaria season, a definite reduction of about 85 per cent in prevalence rate.

In addition to frequent inspections of the houses and cars throughout the season and repeated repairs by the carpenter gang, this result has required personal talks with the foremen and men on the gangs, stressing the mosquito factor in malaria transmission and the almost vital importance of maintaining a mosquito-proof house or car.

Several copies of Doctor Carter's "Malaria Primer" were distributed to the gangs working in malarious sections, and by way of ample proof that they were studied it is recalled that many times a foreman or laborer, not knowing the purpose of the writer's visit, would begin to explain to him the way in which malaria is contracted and methods of prevention.

In addition to the sections referred to on the southwestern division it was found that certain parts of the Savannah division, particularly from Savannah to Wadley, Ga., and also the Augusta branch were suffering from a heavy malaria prevalence. The main line of the Savannah division for a distance of about 90 miles, from Wadley to

Meldrim, is very nearly parallel to the Ogeechee River swamp, the topographic conditions of which favor a high incidence of malaria.

Recommendations were made here as to the amount and character of screening essential, and personal talks were given the gangs and malaria literature distributed. However, the screening was only partially done, with the result that a canvass of 20 section crews and two camp car outfits revealed 33 cases of malaria with a total of 243 days of actual lost time out of 128 men worked through the season, an incidence rate of 25.8 per cent. It will be seen that this does not compare favorably with the splendid record of 6.3 per cent on the southwestern division.

It is almost certain, however, that before the next season rolls around all the essential screening will be completed on this division and a much lower rate of fever found in the fall of 1922.

By means of a monthly company publication known as the Right Way Magazine the educational side of malaria control has been carried to nearly every employee of the system. During the months June, July, August, and September, articles of from half a page to three pages were carried in this magazine, which is sent to everyone on the pay rolls, starting from the seriousness of the malaria problem, and going through the different methods of prevention, and concluding with the measures being used on the Central Railroad and appealing to all employees to cooperate with the chief surgeon's office in this work. As a result much more interest has been manifest in matters of malaria control and sanitation in general than has ever been noted before among the hundreds of men and women in the company service.

While the work this year has been primarily that of affording protection to the Central Railroad employees, the subject of cooperation with communities along the system has been given attention and during the present year three towns in Alabama—Eufala, Dothan, and Hartford—conducted control measures, and Savannah, Albany, and Blakely, in Georgia, with the railroad assisting to the extent of drainage measures on company property.

At Savannah last year, in cooperation with the city, the company expended over $3,500 on drainage of the Savannah yards, and this year's maintenance on this work amounted to approximately $800. The cost of drainage work done in the other towns has not been separated in the records from the regular cost of track maintenance as it has been done by the regular section crews and charged accordingly.

Surveys have been made of eight other Georgia towns on the road, and it is hoped that at least half of these prospects will be induced to start control work in 1922. In fact, it is largely a question of being able to provide trained supervisors to conduct these campaigns. The State of Alabama appears to have better support from the appropriating bodies and is able to provide towns not only with supervision but in many cases with financial assistance. Georgia, on the other hand, has not these advantages, the service engineer being the only malaria-control director working in conjunction with the State board of health.

Therefore the chief surgeon of the Central of Georgia Railway hopes to secure sufficient appropriation in his budget for 1922 to employ one or two trained malaria-control supervisors, not necessarily engineers, in order to assist communities that desire to adopt control measures in accordance with recommendations made by his office, thereby improving the health of resident employees and paving the way for general health betterment which inevitably leads to increased freight output.

It is rather interesting to note the attitude of company officials and subordinate officials on the question of malaria control. The majority of the general officers of the road have long recognized the need and importance of some measures that would reduce their malaria troubles, but a feeling was plainly manifest among some of the subordinate officials, such as supervisors and roadmasters, that little was to be gained by the contemplated measures of attack. Frequently the writer was told that the negro laborers would not sleep in the camp cars in the hot weather and that the screens would be torn off the houses and similar damage done that would render the screening a waste of money. It is true that some of these obstacles had to be overcome, but the major part of the responsibility for the proper maintenance of the camp cars and section houses was charged to the gang foremen and successfully handled by them.

During the latter part of the summer and fall a change of attitude was noted among these formerly rather antagonistic subofficials, who were in the habit of seeing 10 cases of malaria on parts of the southwestern division, whereas this year there appear only one or two cases, and in some sections none. But while these men were rather uncertain of the merit of the work, they cooperated with the writer at all times to the limit of their ability, which at times was a serious financial limitation.

Those of the general officers at Savannah who were inclined to be somewhat skeptical at first were thoroughly convinced of the wisdom of investment in malaria-control work when the so-called "sleeping-ashore ordinance" at Savannah was repealed this summer after several years of contest. This was a rather antiquated piece of municipal legislation, which required all seamen when in the port of Savannah to sleep on shore instead of on board the boats, due to the fact that at the time the ordinance was passed there was much greater chance of contracting malaria or yellow-fever infection around the river front than in the city.

However, due largely to the efforts of the veteran city health officer, Doctor Brunner, and the chief surgeon of the Central of Georgia Railway, the highly successful control campaign of last year was staged and continued this year, effecting a reduction of 80 per cent in malaria prevalence over the rate of 1919. Due to this work largely, the Central of Georgia Railroad, owners also of the Ocean Steamship Co., succeeded in having the ordinance repealed, thereby allowing the crews to sleep on the vessels, a saving of between $7,000 and $8,000 a year that was formerly spent in the furnishing of quarters in town for the crews of boats when in port.

In conclusion, it may be said that the control work and the results secured on the Central of Georgia Railroad this year in the face of adverse conditions confronting the country at large and the railroads in particular were really in excess of expectations, and it is safe to predict that the progress in establishing this work as a regular operating department of the road will only be limited by the unsettled financial conditions and disturbances in the labor situation. When these matters are finally adjusted and a proper organization formed in conjunction with the chief surgeon's office, some very effective and permanent work may be expected along the lines of general sanitation and health betterment among the company employees and the communities on the Central of Georgia system, both of which form the very lifeblood of any railroad and without which the road would soon decline.

DISCUSSION.

Mr. LE PRINCE. I think that if any of us was asked why he came to these meetings he could honestly say that he came here to learn how to do more than his share toward the elimination of malaria from the United States.

During the last 30 days a great number of letters have been sent out asking for suggestions to use in the formation of our program. You will notice on our program on page 64, item No. 15, the subject of economic losses caused by malaria. The idea for that paper was presented by the director of sanitation and chief surgeon of the Central of Georgia Railway. That is the first railroad in the eastern section of the malaria belt of the United States to take up practical applied sanitation so far as it relates to malaria, and we hope that there will be numbers of other roads to follow the example set by the Central of Georgia Railway. Doctor Barrow, chief surgeon of that railroad, will kindly open the discussion. Doctor Barrow.

Doctor BARROW. I am more than delighted to have this opportunity to come to this conference. I have been a very consistent and regular attendant, and have gained a great deal from it. In my work on the Central of Georgia Railway it has been absolutely necessary and essential for me to depend upon the Public Health Service. I appreciated the conditions that existed, but I never had any training in doing that type of work, so I had to turn to some one for assistance and advice. Through the courtesies and kindness of Doctor Fricks, a survey was made on the Central of Georgia Railway and the resulting figures shown were astounding. Just as we started the work, the war came on and we had to stop on account of my absence and also on account of the railroad's going under the care and operation of the Government. When I came back we took it up again.

Mr. Old has told you in a very concise and very thorough manner—and I think he has been most complimentary—what we have done, and I appreciate what he has said. I can't verify—it is impossible for me to verify—what I am going to say, but I know it to be a fact. From the surveys and from my observation on the Central of Georgia Railway in this malaria work, there is not a factor equal to malaria as a cause for economic loss to the railroad. I will go further: In a malaria zone there is nothing that happens or occurs in that zone which can equal malaria in cost or economic loss, leaving out of consideration altogether your health feature, just putting it separately and strictly on a basis of dollars and cents, if you want to measure it that way. In every instance of a malaria survey, where I have had the opportunity to go back and look into it, showing a high ratio of malaria, I can show a corresponding high ratio of poverty. I don't mean by poverty that they simply starve and can't live. I mean poverty in efficiency, poverty in making money, poverty in thrift, poverty in interest, poverty in progress, poverty in all the factors going to make up efficiency—that is what I mean. They don't give the best service on every day they put in. On the other hand, in Georgia wherever there is a low ratio of malaria there is a low ratio of poverty. The minute that your ratio begins to change and your malaria ratio begins to come down, your economic conditions improve immediately; you begin to get better conditions; the mind is more acute, more active, and there is more natural willingness for work. The children's attendance at schools improve and you begin to get good results in their education.

Those are the factors which controlled me in taking up this work. My first step was to get the management to agree, so I had to start a campaign at headquarters. After I got them to start in on a small scale, which I did, then I had to prove to the railroad authorities that a high ratio of malaria existed among the employees—work gangs, station forces, etc.—out on the road. Where this was done I had to start at the bottom and work up, to get the subjected and infected men interested as individuals.

Malaria is not a blanket that you can draw over any area and say the whole thing is going to be wiped out at one time; you have got to start with the individual, and then it spreads to groups, to towns, and counties, and spreads through the State. You have got to have units of control work and then let the units run together, and that is the way, in my opinion, it will have to be done.

Of course, when you come down to the class of employees having the highest ratio of malaria you get into an illiterate class, a class that is hard to make believe or to convince, but you can't force them; you have got to convince them and instruct and educate the men of the work gang in order to get their interest; to get their interest, you have got to get the general foreman of the gang; you have got to get the supervisor, the roadmaster, the superintendent, all up the line, actively interested. We can tell them our methods—screening, oiling, draining, and quinine—but we must convince them of the results if such methods are used. We can't reach each individual on a section gang; we can't make it a general rule to sterilize all the section gangs. I don't believe it can be done. I know that in the Army it failed in many of the dispensaries. The old saying is, "You can lead him to the trough, but you can't make him drink."

What have you got to do to convince the employees? First, get out on the railroad among the employees, talk and explain malaria control—you have got to advertise it. In the general work this has not been done. I am not saying this as a criticism, because I don't think it applies to the field workers; I don't think it applies to the Public Health Service, but there is not enough publicity being given in the United States and in the malaria zone as to the extent of malaria and what it means. People don't understand it; so on the railroads we advertise it. We advertise it exactly as we do our preventative methods for accidents. That is the way we hold down our ratio of accidents on the Central of Georgia Railway until it has the lowest of any railroad in the United States. We advertise it among our men in the shops. Every picture we show is right in front of him, every poster, that if he wears goggles, it will prevent a splinter going in his eyes. It is right where he works; day in and day out he sees it. Every day he sees a sign that he must put on goggles. Every day he sees a picture of a man sitting on a street corner selling pencils where he used to be in a shop. We show it in our monthly magazine, which goes to every employee on the road. We advertise malaria, its cause and prevention, by posters we get out, and we try to get up a different poster every time—something of interest that will make them look at it; instruct them on mosquitoes; instruct them on the advantages of screening; advise them not to use 14-mesh wire but

16-mesh; to put up screens, if possible, by January, and to use only 16-mesh wire. The malaria posters are put in the section houses; placed in all of the offices, in all of the departments, in all the shops; everywhere the employee goes he sees them. That is what I call advertising. It is an educational process and constant reminder.

Now, to figure the benefits we obtain, I can't tell you the number of men who worked in 1919 in the different gangs who had malaria, that we had so many cases, and this year we did not. You may say you get statistics—I don't think so; I think it is an estimate. Statistics, to me, means accuracy, and you can't be accurate in this class of work; it is impossible. I don't talk about statistics in malaria work. In talking about it I say: It is prevalent; it prevails. The extent of it—the per cent of it—does not concern me, whether it is 16 per cent, 18 per cent, or 50 per cent; but it prevails there, and if it is prevalent, let's get rid of it. The direct benefits from it in dollars and cents I can not give you, but there is an enormous field of indirect benefits to railroads on the economic side. It goes up to 300, 500, or 1,000 per cent. These indirect benefits can not be numbered or estimated.

It costs very little to maintain control work. The maintenance is a very small amount of money. We spent something like $3,500 for our drainage in our yards in Savannah in one year—the first year of maintenance was on a basis of about 10 per cent—a small amount after this work. We had no malaria among our night crews, and we used to have a high prevalence of malaria amongst this class. We have had no malaria in our shops for two years, and only one case was reported. The foreman notified me that he had a case of malaria there and I investigated it the next morning, and the man was back at work, and the prescription that the doctor gave him, so he told me, was about a pint of salts, and when I investigated it, I found that he had been suffering for four to five days from constipation, and he reported to the foreman that he had malaria, but it wasn't, and the man has not been sick since, so it couldn't have been malaria. So for two years we haven't had a single case in our shops. Then in 1919, my recollection is, it was 28. I sometimes get mixed up in figures on the malaria side and the accident side. When you figure out the cost of work on engines in a shop, it is expensive; they are all high-class mechanics; they work in units, and they all work together; they know exactly what they are doing. They coordinate, and I am trying to maintain the unit or group intact.

The superintendent of motive power states that he has not lost a man in his shops in the past two years from malaria. I am convinced it is essential that we do malaria-control work in the South.

I have been talking about malaria-control work on railroads; it is limited to a streak of rust going through the South; it is a right of way, a narrow strip, that is all. But we have got to get more publicity. We have got to educate the public; we have got to go to them and teach them what we are doing; that it is necessary to their community and to the individual. If you go to a corporation in a town, if you can not show them that it means an improvement to them industrially to do this malaria work, you are going to find, in nine times out of ten cases, they are not going to be whole hearted in their interest to help you execute that work; but the minute you can show the relation between the health of their employees and the increased output of their mill or corporation, then you are going to get their absolute and complete interest in your undertaking, and they will support it.

Now, that is the business side of malaria control, and it is the most important side; you can not always look at it from a health point of view. Physicians may do it, field workers may do it, but you have got to get the public, and you can only do it, in my opinion, by publicity and education.

This is one of the advantages in getting a corporation like the Central of Georgia—if it had been any other corporation, I would speak of it in the same way. What does it mean in this campaign? The Central of Georgia carries 10,000 employees; the bulk of the employees are adults; 90 per cent of them are married men; they are all being educated in this work; they live in different communities in Georgia and Alabama; they become disciples, and the work spreads. So the assistance they get from a corporation of this kind spreads and comes back to you; it comes back to the United States Government; it comes back to the Public Health Service. I sincerely trust that it will be the policy of the bureau and the men at the head of this malaria work in the South to promote this interest among railroads to take on malaria-control work. You have got to go to every one of them and bring them up to an appreciation of the needs of it. Somebody has got to do it, and it seems to me that it would be a part of your general campaign in the South to get your little units here and there, distributed over a large area, to get them to begin to flow and run together and come into confluent States, instead of isolated States, distributed through the malaria zone; and I think it is worthy of serious consideration by the head of this organization to established this interest among the railroads. Now, I am not trying to say anything uncomplimentary about your policy; I am trying to get you to look at the thing as I do, because, to be successful with my management, I have to keep it on that plane. I am talking about the railroad. Health losses mean money to the management. If they are looking at a healthy individual, they are glad to see the healthy individual, because it means he is more efficient.

If it is possible in any way to start a publicity campaign—you have it in your schools, of course, but let us get the newspapers interested in it. The newspapers can do anything. You know only recently the newspapers were influential in preventing the strike on the railroads. The newspapers were opposed to it. If it hadn't been for the newspapers, you could not have stopped it. I have great respect for the newspapers for molding ideas and conceptions.

Now, I want to take this opportunity to say that I have never in my life, in anything that I have undertaken, received such complete, full, and efficient cooperation from any branch of the United States Government or any other business as I have from the malaria section of the Government. They have given me efficiency and have sent efficient men to me. Not a single man have they sent down to me that I do not consider most efficient. They were interested in the work they were doing. They were cooperative and willing to build up from one small unit, you might say, and this they have successfully done. It has only been a very short while since they have started the work, and I hope in the year 1922 we will have established on the road a real sanitary corps, carrying on all the ideals; all the features of the betterment of working conditions and health conditions in our various units.

The most active units will be in malaria work, and we are going to cooperate with you whenever it is possible to cooperate.

I want you to continue to have interest in us. You started a small child to growing, and he is growing rapidly, and we don't want you to desert him and leave him until he is full grown and he has accomplished his purpose. So I want everyone who is interested in the industrial side of this work to bear in mind at all times that the Central of Georgia is ready and willing to cooperate with you in any branch of this work.

Mr. LE PRINCE. Before calling on Doctor Fricks to make a few remarks I want to state that I believe that every one of the malaria field workers wishes to thank Doctor Barrow for his remarks.

We shall hear from Doctor Fricks.

Doctor FRICKS. Mr. Chairman and gentlemen, I certainly can not refrain from returning Doctor Barrow's compliment. It has been an extremely great pleasure to me to be able to cooperate with the chief surgeon of the Central of Georgia Road in this very important work. I have discussed it with him many times, and I have always been impressed with the intense interest that Doctor Barrow has taken in malaria control.

Many of you know that railroad malaria control has been a matter of deep interest to me since I was assigned to the direction of the malaria work of the Public Health Service. I see clearly that the railroads are avenues through which we can approach the people of the South who are most interested in malaria control—those who are suffering from malaria. The people of a small community look up to the railroad and the railroad officials in their locality as standards of efficiency, and whatever the railroad does, or whatever the railroad recommends, the average small community—and those are the ones in which we are particularly interested—is glad to pattern after. In addition to this, it seems to me that the railroad organization offers to a sanitary engineer a logical position in which he can accomplish much—not only in malaria control, but also in general sanitation and the care of water supplies. It seems to me perfectly obvious that within a few years all the railroads of the South, at least, will have created such positions and will be employing efficient sanitary engineers at relatively good salaries to carry on the sanitary work of the railroads, simply, as Dr. Barrow has said, to improve the efficiency of their employees and secure additional financial returns.

As I have said before, we are not particularly interested in motives or why the railroad should be interested in malaria control; what we want is to get results.

The obstacle that has been in our way, hindering more general cooperation in railroad malaria control, has been the fact that we had entered into a cooperative program for malaria control which required all of our allotment and personnel; but in so far as it was possible to do so with our limited funds, surveys have been made and demonstrations in malaria control conducted on the railroads most interested. I should remind you also that the Public Health Service has certain policies and certain legal restrictions covering its field of activity. It is imperative that we cooperate with the State and local health authorities.

I am greatly pleased with the progress which has been made in malaria control on the Central of Georgia, and I assure Doctor Barrow that we are not going to leave his tottering infant before it is propertly weaned.

Mr. LE PRINCE. We need the counsel of our consulting adviser before taking up the discussion of so important a subject as this.

Doctor CARTER. Mr. Van Hovenberg ought to speak on this question. I would just like to say this: That in the beginning of malaria-control work in the United States what was stressed was the economic side of such work. Mr. Le Prince well knows how, in looking for places for malaria control we practically had to confine ourselves to industrial communities in preference to the ordinary towns of the South—the industrial community around the sawmill, the cotton mill. The commissioners and the mayor were not willing to spend anything, so we interested the people who were business men and stressed the economic value of malaria control. Mr. Chapin some years ago tabulated the amount of benefit in money which was given by a unit of sanitary expenditure; putting so much for tubercular control, so much for intestinal disease, and so on, and he was entirely satisfied if he got 12½ per cent per annum as a sanitary standard. I would feel dissatisfied if we did not get 33⅓ per cent as the malaria standard. I know in a few cases we have got 100 per cent.

The commencement of malaria control on railroads was made in the spring (March and April) of 1917. The Cotton Belt Railroad had applied to the malaria office for an engineer to take charge of their sanitary work. Mr. Le Prince had selected a man, one of his old sanitary inspectors in Panama. He agreed to come and then changed his mind. Just at the beginning of the war the whole thing looked like it was going to fail, and both quick and decided action seemed necessary. All of our field men—three of them—and Mr. Le Prince were sent to Texarkana, planning to pick out the best man available there and give him all the help and instruction we could and leave him in charge of the work. Mr. Le Prince selected, I presume, the best man in the United States for the job—Mr. Van Hovenberg; showed him everything possible in the time at his disposal, gave him what help was possible, and left him in charge of an entirely new problem. You know how he has handled it.

We hoped that if it commenced on one railroad it would go to the others. Only one of them has taken it up since that time—the Central of Georgia. They claim they can not afford the expenditure, but to my mind they can't afford not to make the expenditure. They spend four times as much for the loss of labor by sickness as they would to prevent the sickness. Railroad control was taken up because we thought it would be an effectual means of starting the work in different places, and so it has turned out on the Cotton Belt. I don't know enough about the Central of Georgia to say. In the country which the railroad goes through they are influencing by their work a considerable number of small towns. A number of industrial plants on their route have undertaken malaria control also. I think it is fair to say that the work of the Cotton Belt has affected 24 times as many people and has protected 24 times as many people from malaria as the Cotton Belt numbers employees, not only their families, but the people on their line who see the result on the railroad, and apply it themselves. It is one of the biggest publicity agents you can possibly imagine. I hope it won't stop at those two roads, and I am sure that no railroad that has ever undertaken it will stop it; it would be too great a loss. I am hoping that other railroads that run into the South——the Mississippi Valley, the Texas Pacific, and so on—will find that they can not afford not to do this work.

Mr. Le Prince. We have about 15 minutes now for discussion. We want to hear from Mr. Van Hovenberg.

Mr. Van Hovenberg. Mr. Chairman, Doctor Carter, with his usual kindness, has probably flattered the Cotton Belt a good deal too much. He was largely responsible for the creation of the work and has been keeping a fatherly eye on it since that time.

I must say a word of appreciation of the malaria office, which has given the Cotton Belt about all the assistance we asked for. I sometimes think that Doctor Fricks is not always pleased to see me come in the office, because he knows I want something more. But I know his heart is in the right place, even if he can not always give me what I want.

I want to say a word about something the engineers can do for railroads. Some of the railroads of the United States are now being valued by the Interstate Commerce Commission. We know that in the North the cost of engineering on preliminary survey and location is about 4 or 4½ per cent of the cost of building the railroad. We know that in the South the cost of engineering in building a railroad is at least 7 or 8 per cent. If any of you can give the chief engineers of railroads any information on the excessive cost of surveying parties in the South, due to malaria, it will be appreciated. The difference between 4 per cent and 8 per cent will add thousands of dollars to the valuation of railroads.

I would like to say a word on the value of quinine prophylaxis as compared with sterilization. After four years of experiment I feel that there is a reasonable doubt as to the dollar and cents value of issuing quinine in immunizing doses over the line. I believe we would do better to search out the infected men and get them to the hospital for sterilization. The man who is infected is worth little to the road and is probably being paid more than he returns in labor. A man may, by taking small amounts of quinine, stay on the job, but he is doing himself an injustice as well as the railroad. I would advise searching out the men that are sick and then using the quinine to cure them. While this is being done, teach them how to protect themselves from new infections.

Mr. Le Prince. The subject is open for short discussions. Is there any further discussion? If not, Mr. Old will please close.

Mr. Old. Doctor Carter mentioned the protection of individuals in the towns along the railroad. We are trying to get the towns to take up the work and give them all the inducements we can. The town of Millen, Ga., asked recently that a survey be made, and I spoke of that yesterday in connection with fish control. We blew up about 1,200 feet of ditch, and I think there were 5,000 people at the demonstration. Last month when I made the survey I had a meeting with the council and told them a good bit of the work would be dynamiting, and in a few minutes they told me to go ahead; they authorized the appropriation. I think it was largely due to the spectacular effect of the dynamite.

The officials of the road read the articles in the company magazine. In July or August I left Savannah on the sleeper one night when there were three officials on the car—one a division engineer, and another the agricultural agent, and upon talking with them in the smoking compartment I found everyone of the officials had read the malaria article in the magazine just distributed that day.

I don't believe there is anything else I can say in closing this paper except that the Central of Georgia is going ahead in this work, and I believe they have a good field for malaria-control work.

Mr. SMITH. I should like to confirm the statements of these gentlemen by repeating that we are doing excellent work, and that the public have already begun to appreciate our work and its results. I wish to thank the Public Health Service for the earnest consideration and help given the city of Savannah.

Mr. LE PRINCE. The next paper on the program will be "Methods of approaching the medical profession, the general public, and administrative officials relative to malaria investigations, by Doctor Coogle. Give us the first part first—methods of approaching the medical profession—and we will discuss that before proceeding with the remainder of the subject.

METHODS OF APPROACHING DOCTORS, MUNICIPAL AUTHORITIES, AND THE GENERAL PUBLIC RELATIVE TO MALARIA INVESTIGATIONS.

DR. C. P. COOGLE.

Acting Assistant Surgeon, United States Public Health Service.

My object in presenting this paper is to relate my own experiences and invite your frank discussion as to what is the best method, if there is such a thing as a definite method, of approaching these people whose active cooperation is so necessary for the success of field investigations of malaria.

I realize in the last analysis the method of approach must depend upon the personality of the one making it. At the same time, there are certain fundamental principles which are common to all transactions of this kind and which it may be helpful to enumerate in order that we may have a clearer understanding of the factors involved.

The principle is that of salesmanship. We must present our product just as the successful salesman does; we must properly approach our customer; we must establish confidence in our line, secure orders that are as large as is commensurate with good business, and retain our customer in a satisfied and contented state of mind, so that he may deal with us in the future. This latter is of special importance in our work the success of which depends so largely upon efforts sustained throughout a period of years rather than months. Our transactions should be as permanent as possible in character. To do this we must build upon a solid foundation.

We should apply the principles of salesmanship to the three groups with whom we have chiefly to deal.

(1) METHOD OF APPROACHING DOCTORS.

It may be laid down as a general principle that it is always better to have the physcians of the community actively interested in the work. Their earnest cooperation will be of tremendous assistance and is to be sought with persistent effort. In this connection it may be pertinent to remark that whenever possible it is better that the approach be made by a medical man, for reasons that are obvious. This is particularly true where the campaign involves special emphasis on the administration of quinine.

In general campaigns against malaria it is advisable to have the indorsement of the local medical society, and it is preferable to present an outline of the work before a meeting of the medical society. Whenever possible, the paper should be made attractive by specimens and pictures collected under local conditions.

In the discussion that follows this paper very often one can gain an idea as to the sort of reception his program is likely to receive from the local profession. You may have an opportunity to win over the doubting ones by making clear what obligations the medical society owes to the community from a public-health standpoint. When it is impracticable to present the matter collectively before the medical society it is important to visit the physicians individually. It is my policy to try to enlist their interest and make them feel that they are a part of the machinery of control operations.

Discussion.

Mr. Le Prince. The subject of methods of approaching the medical profession is open for discussion.

Doctor Bowers. Mr. President, it occurs to me that the doctor might have mentioned one of the most important means of reaching the medical profession, which is the preparation of strong, concise, convincing arguments presented in the local medical papers. We have a very excellent journal here in the South, the Southern Medical Journal; and it seems to me, in going through a recent half dozen issues, I missed that note of solicitation that Doctor Coogle is attempting to institute in his paper. I think it would be well for you gentlemen down here to bring pressure to bear on this paper for a little more definite cooperation in the line of general publicity and what it means to the subject of malaria control.

(2) METHODS OF APPROACHING MUNICIPAL AUTHORITIES.

Doctor Coogle. In approaching municipal authorities, it is considered practical to prepare the way. Diplomatic notes from the State board of health can often be secured or sent in advance of your visit, rendering the task of the field worker easier to accomplish. It is of great advantage to be acquainted with the political line up of the town and the financial condition of its treasury. The ideal approach is secured when the way has been paved by the State board of health and your visit is by invitation from the municipal authorities.

In this connection the engineer may have an advantage over the physician. The laity (particularly town councils) are rather skeptical about the practicability of schemes propounded by physicians and are apt to consider them visionary. . On the other hand, the engineer inspires a feeling of confidence in the practicability and soundness of the undertaking. They are better able to convince municipal authorities that what they are proposing is a matter that belongs to a good organized municipal government just as much as the provision for safe water supply and the proper disposal of sewage and waste. Hence, it would seem desirable wherever possible that this task be assigned to an engineer rather than to a physician. An effort to stimulate general enthusiasm is desirable, though undue optimism relative to ultimate results should be avoided with the utmost care.

(3) METHODS OF APPROACHING THE GENERAL PUBLIC.

House-to-house visits, which we sometimes have occasion to make, are more for special information than general field investigations of malaria. The number of field workers are so small the task is too large for us to hope to solve this problem by this method. Through organizations, business men's clubs, women's clubs, lodges, and schools we find the best mode of approaching the general public.

In this connection it is advisable first to be aware of the standing of the clubs in the eyes of the administration and in the eyes of the public before enlisting their support. Everyone knows that these organizations may be of tremendous assistance in any campaign, provided, of course, that these organizations function harmoniously with the administrative authorities and are popular in the eyes of the general public.

It is well to keep in mind that the enthusiasm of all civic organizations relative to our subject is just a thing of the moment and can only be maintained by energetic field work and systematic and guarded field publicity. As in all other public-health work, the schools offer one of the best means of approaching the general public; here the most attentive and impressionable audience can be obtained.

In taking the spleen rate and getting the parasitic blood index of school children in southwest Georgia I have been impressed with the great value of explaining to them in simple language the principle of malaria transmission and how it can be combated. Indeed, in any campaign of which children can take part I should put this as a means of first importance in our effort to reach the older people. The child in its simple language carries home the story; it reaches the parents and older members of the family as coming from the local center of education. I have so far received no criticism from parents or school authorities of this work among school children, and indeed have reasons to believe it is being well received.

In my work I have used a simple story, much like the one outlined by Doctor Carter in his malaria primer, except that I have omitted scientific details and tried to put the matter in language that is easily understood by all. I use blackboard illustrations to hold attention and use local color and comparisons with the natural phenomenon with which every child on the farm is familiar. Jingle rhythmical verses on malaria are taught the children. Following the completion of the story and rhymes, I then quiz the children to be sure that they have the correct understanding of the message I wish carried home. In substance, it affords a method of quickly reaching a large proportion of the farms of the community with a knowledge of how malaria is transmitted and what we are doing to prevent it. The folks at home are being taught by their future prospects, in whom they have a natural confidence. In this method we really kill three birds with one stone.

1. We are getting perhaps the most reliable information as to the prevalence of malaria in that community.
2. We are teaching the future citizens of that area how malaria is transmitted and that it can be prevented.
3. At the same time we are preparing the folks at home (through the children) for the subsequent work we expect to do in the field.

DISCUSSION.

Mr. LE PRINCE. The subject is open for discussion.

Mr. E. B. JOHNSON. Mr. Chairman, Doctor Coogle brought up one point there which I want to emphasize, and that is you must be careful in approaching the municipal authorities or general public, either through the local organizations or directly. In the spring of 1920 in one town they had no Rotary or civic club. I believe they had what they called a "Get Together Club," and I tried to get the interest of the city officials through them and I failed.

Why I didn't know. About three months later—I visited the town quite frequently, because I had already made up my mind that I was going to get it in 1921—I found out that the "Get Together Club" and the mayor were just like two fighting cocks; that if one wanted a thing the other didn't want it. I went at it a different way, and I didn't have to do any work at all; they came to me instead of my going to them.

Doctor KIBBEY. Mr. Chairman and gentlemen, I would like just a minute of your time to tell of a method used by us on one occasion to get some of our ideas to the people through the school children.

The corporation by whom I am employed has some 27 different camps—industrial villages—in connection with their various industrial operations.

It has been the practice of the sanitary division to try to control mosquito breeding completely rather than to limit our efforts to only the control of the malaria-carrying varieties.

In one of our villages, consisting of 840 houses, all of which had been equipped with metal roof gutters, and which was situated in what had originally been pine woods, with many of the trees still standing, we found last summer Culicine breeding in nearly every roof gutter in the village.

On account of industrial conditions prevailing this year our sanitary forces were operating with limited funds and reduced forces. Both our departmental superintendent and myself decided in this instance to confine the activities of the sanitary forces to the actual control of malaria and to undertake to educate our people to the extent of having them relieve themselves of the pestiferous mosquito.

A sanitary inspector and one foreman was detailed to make a house-to-house canvass, explaining to the people—all negroes—that the numerous mosquitoes were not the malaria-carrying variety and instructing them in the care of the roof gutters so that breeding might be prevented.

This was without visible results.

Two very well-attended schools were maintained in the village. A meeting of teachers and the older pupils was called and an hour spent in explaining, with demonstrations, the life cycle of the mosquito.

Screened glass jars, containing both larvæ and pupæ, were left at the schools for further demonstrations by the teachers, and in a week every breeding place in the village had been destroyed as such.

I am simply mentioning this as illustrative of the value of the school child in helping to put over something which you are desirous of getting to the people.

Doctor Bowers. I have been doing a little work in New York in the matter of oral prophylaxis, and find that in going into a class up there and teaching the dangers of focal diseases, pyrrhoea pockets, and care of the condition of the mouth, that they learn these lessons and take them to heart, carrying the enthusiasm home with them, tell the family about this, and use a general method of prophylaxis from that time on. I don't see why that same thing couldn't just as readily apply to malaria control.

Doctor Coogle, your publicity proposition, I can tell you from the inside of the sanctum sanctorum, is a purely local one. Just before I left New York to come to this meeting I spoke with Mr. Bigelow, of Good Housekeeping Magazine, and I put up to him the responsibility of a magazine editor in helping to popularize information in connection with some great project of health conservation. "Well," he said, "Doctor Bowers, what you have to say is interesting. I know the men down there are doing great work, but our magazine circulates in a community which is 90 per cent nonmalarial. We couldn't write special articles for 10 per cent of the readers."

And I had the same conversation with Mr. Webb, of the International Service Magazine, for which I sometimes write editorials. He made exactly the same remark as Mr. Bigelow. That manifested to my mind the fact that you have to employ your local means of publicity, your newspapers, and your local medical journals and other mediums, in which you can get your message for malaria control across.

Doctor COOGLE. I want to thank Doctor Bowers for his expression on publicity in magazines.

Mr. LE PRINCE. One of the large screen manufacturing corporations upon request has sent a represenative to this conference. Mr. Beers will present a paper on screening.

(Mr. Beers read a paper on screening.)

DISCUSSION.

Mr. LE PRINCE. I wish to ask a question, Mr. Beers. I understand practically what you have written is to be used as printed propaganda.

Mr. BEERS. Yes, sir.

Mr. LE PRINCE. To be distributed?

Mr. BEERS. As a pamphlet. It is the basis of our advertising.

Mr. LE PRINCE. We want to have more effective screening done in the malaria belt and more homes screened. Are there any suggestions of improvements for the pamphlet? We are interested in perfecting screening. Screening is one of the methods of protecting the home and the family. Will anyone who has any suggestion to make regarding this matter, which will aid in the elimination of malaria from the United States, do so?

Doctor GRIFFITTS. Mr. Chairman, I think everyone who is interested in health matters, and especially malaria, is very much interested in the screens and their manufacture. I believe that a great good can be done by the screen manufacturers if they put the matter squarely and correctly before the public. I don't believe that the manufacturers can make a better investment than to have their literature censored and absolutely correct, so there is no misinformation or misinterpretation when the literature—or, rather, advertising matter—goes out. They can play an important part in certain public-health work.

The life of any screen material depends to a great extent upon the way that material is used. Doctor Carter will recall that we screened most of the town of Gilmerton, Va., and most of the work was done with galvanized cloth. In one house there, on examination a month ago, that material is in good shape now, after a little over four years' use. The occupants of that house are elderly people and are very careful. It is the only house in town on which that material was put where it is intact to-day. This is the last season of the life of that material.

Doctor CARTER. Five summers?

Doctor GRIFFITHS. This is the fifth summer; yes, sir. But in the houses where doors are slammed, or children are playing with the screens, when a certain amount of rusting or corroding has taken place, your screening material will go to pieces. Some of it is simply hanging up there; even a strong wind will knock some of it out. Cloth material, fabric, cotton, and linen, I thought was going to last very well, but it actually went to pieces without mechanical injury. It apparently has no particular advantage, even in the salt atmosphere, over galvanized material. The screen manufacturers getting into the game are absolutely on the right track, and they are capable of assistance in public-health work. They should not only know how screens are made but for what purposes they are properly used.

Mr. PARKER. Mr. Chairman, we are not working in every town in the malaria belt, nor in every rural community in the malaria belt, but we have an agent, in a way, in every town, I believe, regardless of its size, and he is the hardware merchant. The class of wire that he handles and the mesh of that wire has a great bearing on what the farmer, particularly, is going to screen his house with. I have investigated and found that the farmer comes in for some wire screen and gets what the hardware merchant has to offer. It may be 12; it may be 14; sometimes it is 16 mesh. He knows nothing about the mesh that he has to obtain to screen his house against mosquitoes, and the hardware merchant has something to sell other than information. In some instances I have been able to correct that and have the hardware merchant return the 12 and 14 mesh wire and carry only 16 mesh, so when the farmer comes in to buy he will get what he needs.

Mr. BEERS. I know there is going to be an educational campaign inaugurated to reach the hardware merchant, and we are going to cooperate with you in introducing 16-mesh to the hardware trade.

Doctor CARTER. I would like to ask one question. I have nothing to measure with here. The wire in your heavy wire screen was unquestionably heavier than what I was in the habit of seeing in screens. Is not that 16-mesh about the same ordinarily as the old 18-mesh?

Mr. BEERS. Practically; a fraction larger.

Doctor CARTER. Now, there is one thing; the finer the mesh the more mosquitoes it excludes. The stegomyia mosquito can go through the old 16-mesh a little, not much. On the other hand, the coarser the mesh that you can afford to use the better it is, because it does not keep out air. The trouble has been the complaint of keeping out air, and I expect for Anopheles—that is, for malaria control—your 14-mesh very likely is the old 16-mesh. The wire that I have just handled there is 16 meshes to the inch; has a mesh apparently no greater than the old 18-mesh you mention. Have you any 14-mesh?

Mr. Beers. There is a piece of 14-mesh copper that was in use some 14 years taken from a screen at Ocean City. [Indicating.] Here is a letter from a man that has had it. He says that has been used constantly on a second-floor window, southern exposure, and has been used some of the time winter and summer.

Mr. Le Prince. We should like to know the locality of that place you mentioned.

Mr. Beers. Ocean City. It is a small place on the coast, south of Atlantic City, N. J.

Mr. Le Prince. I am sure everybody here would like to know the extent of the screening industry; how much is sold each year.

Mr. Beers. Of course there are no statistics about that, but in a general way I should say that the public pays $25,000,000 for screening in the United States every year.

Mr. Le Prince. Are there further questions?

Mr. Stromquist. In regard to putting this over with hardware men, I think that will be entirely possible, for I know that in Memphis you can not buy anything but 16-mesh. I tried to get samples of 12 or 14 mesh, and I haven't been able to find it in town.

Mr. Beers. There is an ordinance in Memphis that prohibits the sale of any but 16-mesh. I was talking to a hardware man last spring, and he said he had to sell his 12 and 14 mesh outside of the State.

Mr. Le Prince. That was in the State of Tennessee?

Mr. Beers. Yes, sir. In Arkansas; he said he sold it over the river.

Doctor Carter. What is the cost of the 16, heavy?

Mr. Beers. Well, the 16, heavy, would reach the public at about 15 cents a square foot, and the regular grade I should say could be sold for 8 or 9 cents by the roll.

Mr. Le Prince. Any further questions?

Mr. Stromquist. The galvanized cloth screen was selling in Memphis last year for about 5 cents.

Mr. Le Prince. We will adjourn until 2 o'clock.

Afternoon session, November 16, 1921.

Mr. Le Prince. The first paper on the afternoon program will be "Fish-control observations," by the State sanitary engineer of Georgia, Mr. H. C. Woodfall. Mr. Woodfall is absent and has asked Mr. Foster to read that paper.

Mr. Foster. Mr. Woodfall told me that he regretted his inability to attend and thereby be able to meet you gentlemen whom he has known so well before, and he further told me to tell you that his heart was with you and he hoped to be with you at a future time; that unfortunately at this time the state of the budget of the Georgia State board of health forbade his attendance. [Reading:]

MOSQUITO CONTROL BY MEANS OF SMALL FISH AND METHODS EMPLOYED FOR THEIR MULTIPLICATION.

H. C. Woodfall,

Chief Sanitary Engineer, Georgia State Board of Health.

I wish to give a brief account of fish-control work at a small pond, located just outside the town of Warwick, Ga.:

This pond is formed by the erecting of a dam for milling purposes. A number of years ago a pond existed in this spot, which pond had been abandoned and the dam, through lack of attention, washed away and was again erected so flooding an area of about 17 acres.

Warwick is a small town in southern Georgia, having a population of 274, and is wholly a lumber and agricultural community. It was reported that previous to the erecting of this milldam the second time, Warwick had very little marlaria, which increased rapidly after the dam was erected.

Surveys, made by the State board of health, showed that malaria was always very prevalent in this community and that it was doubtful whether a very marked increase in malaria had occurred after erection of the dam. There was also presented for thought the question as to whether the fear of the pond was due simply to the imagination of certain individuals living in this town.

Warwick is an incorporated town, its limits being a circle having a one-half mile radius. This brings the edge of the incorporation within a short distance of the upper end of the pond. Previous to January, 1920, certain people of Warwick took an injunction out against Mr. Williams, owner of the pond, who was tried on January 3, 1920. The decision of the court is here inserted as a matter of interest to others who may have such a situation to deal with.

Copy of judgment.

R. A. Posey et al.
v. } Petition for injunction, etc. Crisp, Superior Court.
H. R. Williams et al.

The above-stated case, the same being application for permanent restraining order, seeking to restrain the defendants, their agents, servants and employees, and all persons under or for them, from erecting a milldam and creating a mill pond at the site of the old Hunt mill on Mill Branch, in Worth County, Ga., and there doing anything toward establishing and maintaining said mill pond, came on to be heard before me at Cordele, Ga., pursuant to previous order of the court, on Saturday, the 3d day of January, 1920, and the same was heard upon affidavits and documentary evidence submitted by both sides.

Now, after consideration of the same, and the arguments of counsel, it is considered, ordered, and adjudged by the court that, until further order of the court, the restraining order heretofore granted in this case on the 15th day of December, 1919, be, and the same is hereby, revoked, and the restraining order prayed for is denied, upon condition that the defendants, before completion of the milldam and mill house complained of, cause to be removed from the slopes of the embankments of Mill Branch above such milldam all grass, weeds, moss, and shrubbery that would prevent the free movement of minnows, fish, etc., in the shallow water on what will be the edges of such mill pond when the water is raised to the full height permitted by such milldam, and shall also cause to be removed all tree tops and logs that will not be covered by the waters of such pond when raised to the height permitted by such milldam.

It is further ordered by the court should this case for any reason not be tried at or by the trial term thereof, and such failure to try be brought about by the defendants, that then the petitioners may have leave to renew their application for interlocutory restraining order as prayed for.

Let this order be entered on the minutes.

At chambers, Fitzgerald, Ga., January ______, 1920.

____

J. S. C. C. C.

On July 23, 1920, the State board of health made an inspection at Warwick to determine whether this pond was responsible for the malaria prevalence in Warwick, and further, whether the decision handed down by the court had been obeyed. It was also further desired to find out whether there were not certain breeding areas in the town which might have been responsible for this condition. At this time it was found that very little breeding was occurring in the pond and that certain work had been done relative to clearing the edges.

In the very center of the town itself a ditch was found with Anopheles mosquitoes breeding heavily. It was reported by the people that this ditch never held water longer than two days, and yet Anopheles were found that were seven and eight days old. Directly adjacent to this ditch in a barn numerous *Anopheles quadrimaculatus* were found.

Between this ditch and the pond was one other ditch, which at this time contained numerous half-grown Anopheles larvæ. All barns and other sheds were inspected between the town and the pond for adult mosquitoes, and in no case were any found. It was concluded at this time that ditches located in the town were responsible for the malaria prevalence and not the pond itself. After this inspection it was recommended that this pond be well cleared and that it be heavily stocked with Gambusia. A representative of the State board of health and the owner of the pond went to Savannah and brought about 2,000 Gambusia to this pond.

In March, 1921, an inspection was made, and it was noticed at that time that the Gambusia were very plentiful along the edges of the pond. Eighty-six dippings were taken in the most likely breeding places around 75 per cent of the shore line of the pond. Eighty-five of these dippings showed no mosquito breeding whatever, while one dipping showed one Culex pupa. The branch, which feeds this pond and which was breeding heavily a year ago, was at this time 100 per cent under fish control. The ditch which had been breeding so heavily in the town had been reditched and drained and was dry at this time. One female *Anopheles punctipennis* was found in a cow shed, which at previous date had shown an enormous amount of *quadrimaculatus*.

On June 29, 1921, a second survey was made, and along the sides of the pond there was almost no breeding. No adult larvæ were found. Along the dam very heavy breeding was found both of Culex and Anopheles mosquitoes. No Gambusia were found in this locality of the pond, due to the fact that the waters along the dam offered no protection to the Gambusia and they were easily attacked by the larger fish.

On July 6, 1921, after the heavy breeding had been found along the dam, it was thought best to try to eradicate the larger fish in the pond, so with the cooperation of an assistant sanitary engineer of the United States Public Health Service work was carried out, as is described in his letter now quoted.

> On Thursday, the 7th of July, the matter of reduction of large fish in the pond near Warwick was under way as by means hereinafter described, and other work was done as had been directed in your letter to Mr. Williams.
>
> Early on the morning of the 7th Mr. Williams carried a force of a foreman and about 15 laborers to the pond (pond had been drained quite low by the opening of the gates on the night before) and he had the margin of the pond cleared for a strip of average width 40 feet of all small-bush growth and he had logs removed on such strip. On the north side of pond, at about mid length, there was a collection of about five trees recently uprooted and fallen into pond, yet green, and they being such a great difficulty he said that he proposed to leave level low and let trees dry before burning all he could of the "lop" of them and then would remove them. The clearing was as well done as it seemed "practical" to require it. He used dynamite in deeper water and put into creek several hundred pounds of lime at the road. Then he put in a mixed force of negroes in his employ and let a dozen or more white men go into stream and pools and collect fish. They so "grabbed" the route and took many fish, probably 250 to 300 pounds of fish of all sorts were taken, but not a few were catfish and suckers. Many perch were taken and some bass and pike.
>
> The job was very repressive of large fish in general, but to do much good would have to be repeated annually, which he said he would do. I fear that practically no Gambusia survived in the pond area. There were such in the branch above the pond after the liming, but I think that only those survived.
>
> It would be in order that some one see the pond two weeks hence to determine whether enough Gambusia are then present in pond to serve to any purpose.

Williams does not wish to do away with all big fish, at any rate did not wish to use poison beyond a stupefying ordinary lime. He made a good catch of big fish and says he will do so each year. His clearing was very good.

Thereafter and on date August 3, 1921, a trip of inspection was made by the State sanitary engineer. Observations as from such inspection are better made known by means of the following report addressed to the commissioner of health of the State of Georgia, the same bearing date August 15, 1921:

The inspection of this pond covered the same general outline as was taken at the time inspection was made and report written on June 29; that is, the pond was divided into three sections. Section 1 extending from the dam along the side of the pond adjacent to the roadway, section 2 extending along the foot of the dam and section 3 extending from the dam back along the other side of the pond. The results of this survey showed the following:

GENERAL.

At the time of this survey the mayor and other citizens of Warwick interested in the malaria problem, with Mr. H. R. Williams, owner of the pond; Mr. J. G. Foster, of the United States Public Health Service; and myself, representing the State board of health, made a very careful inspection of this pond to determine the relation this pond might have at this time on the malaria incidence in and about Warwick.

On July 7 Mr. Foster and Mr. Williams lowered the water level in the pond, drawing all the water from the pond that could be drawn through the existing gates. After this was done all the game fish were caught, as far as possible, which amounted to about 400 to 500 pounds. All Gambusia caught were put back into the water again. On the inspection in July a very heavy growth of chara grass completely covered the cleared end of the pond. On August 3 this grass had wholly disappeared, and it is believed that the lowering of the water in July killed this grass, which formed masses upon the raising of the water and floated out through the sluice gate.

On August 3 it was noticed that Mr. Williams had done an immense amount of work around this pond, following out the recommendations that were made by the State board of health. The shore line had been well cleared around the total edges of the pond, which clearing had beeen carried beyond the dead waters of the pond up the feeding branch to the Warwick-Cordele Road. Just previous to the inspection on August 3 a heavy wind swept through that locality, blowing into the pond several large trees. These trees are to be pulled out and left on the banks of the high-water line of the pond. It was further noticed at this time that the Gambusia were very plentiful and very few game fish were noticed. On inspection in July no Gambusia were seen along the foot of the dam, while in August, after probably over 80 per cent of the game fish had been removed, the Gambusia were plentiful along the foot of the dam.

Section 1.—Along this section 27 dippings were taken, and only 9 dippings showed mosquito larvæ, which in the majority of cases were Culex. No pupæ were found along this edge. All of the larvæ which were in this section were small size, showing that along this edge the fish were doing very effective work, and probably very few adult mosquitoes were getting away.

Section 2.—Fifty-five dippings were taken in this section; that is, along the foot of the dam. In June this area showed very heavy breeding of both Anopheles and Culex mosquitoes. At this time 26 of the 55 dippings showed negative, 21 showed an average of 1 Anopheles larva per dipping, 12 dippings showed 1 Culex larvæ each. All of the larvæ found at this time along the dam site were very small, which showed that the fish were very active, and it is very improbable that any adult mosquitoes were getting away from this edge.

Section 3.—Forty-eight dippings were taken along this section, and only 3 out of the 48 showed any larvæ whatever. Fish were very active along this edge, being noticed by the hundreds.

CONCLUSION.

From this survey made on August 3, I believe Mr. Williams has done everything in his power to stop mosquito breeding within his pond. The inspection on this date showed that the pond is as near under fish control as any pond can be, and it is believed that this pond has no effect whatever on any malaria that might exist within the town of Warwick or the surrounding territory. I believe that if Mr. Williams will once a year draw off all water passed from the pond and catch all the game fish possible, and, further, do a small amount of clearing, that this pond will be a benefit to the town of Warwick rather than a pond causing a nuisance and sickness amongst the citizens.

I believe that the State board of health has done everything in its power to get this pond so that it is not a health nuisance, and I believe the result anticipated has been obtained.

Due to the fact that Worth County has a very efficient whole-time county health officer, I believe that in the future surveys and follow-up work should be carried on from his office, and at any time he finds anything that may be favorable to the producing of malaria mosquitoes he should get in communication with Mr. Williams or the State board of health, and I believe the cause can be readily eliminated. Further, due to the fact that the State board of health is very much interested in the control of malaria, and especially in fish control in ponds, I believe we should make, through this division, an inspection of the pond twice a year.

DISCUSSION.

Mr. Le Prince. Mr. Hildebrand will give us a talk on fish control.

Mr. Hildebrand. Mr. Chairman and gentlemen, there is one point in the paper just read that seems to be of special interest. I refer to the statement relating to the absence of wiggle tails in the deeper water. I was much surprised that when some of the game fish were removed the Gambusia did go into the deeper parts of the pond. My observation has been that even if there are no game fish present that Gambusia usually will not enter the deeper waters. They like the shallow places, and in ponds in the localities where I made observations we had some trouble getting them to enter the deeper water. This probably is one of the things the big fish, by many years of policing, have taught them—i. e., by destroying or driving back those that venture into deep water. This keeps the little fish where they really belong, and even if the big fish are removed from a body of water the minnows still mostly stay in the shallow waters. Mr. Chairman, do you wish me to discuss my work of the past summer?

Mr. Le Prince. Decidedly.

Mr. HILDEBRAND. I shall endeavor to give you only a brief outline of some of the things which I tried to do. Some of the experiments produced positive results and others, of course, were negative.

The first point that I may mention is a study of the death ratio of the sexes of Gambusia in transportation. It may be of interest to state that the male appears to be the weaker sex, as proportionately a greater number of males than females were lost in transportation. Of 1,224 males held in confinement from one-half to seven hours in transportation, 337 died, while out of 3,935 females contained in the same lots 730 died. The percentage of deaths among the males, therefore, was 9 per cent greater.

I have been asked by one of the field men to offer some suggestions for transportation of top minnows. It is extremely difficult to lay down fast rules, as methods that work satisfactorily in one instance may not work in another, for the weather and water conditions constantly vary. I prefer to use large-mouth vessels rather than the commonly used milk can, as it seems important to have as much of the surface of the water come in contact with the air as possible for the absorption of oxygen. I have used lard cans and lard tubs with success. The wooden tubs gave the best results when no insulation was used. If, however, the tin cans are covered externally with a wet jacket of burlap or other suitable cloth, they are equally as serviceable. If the fish are to be transported a long distance during warm weather, it is advisable to place the containers in a box or crate, surrounding the cans with wet packing, such as excelsior, hay, or other suitable material, in addition to the wet jacket.

The number of fish that may be transported in a container of a given size must be determined by the temperature and the length of time the fish are to be held in confinement. During cool weather a much larger number of minnows can be successfully shipped in a container of a certain size than may be handled in the same container during hot weather. When the weather is cool from 200 to 300 minnows may be safely shipped in a 60-pound lard can, providing that they are not held over 12 to 24 hours, but in warm weather the number will have to be reduced to about 75 or even to 50. Allow me to suggest that whenever you have minnows to transfer and can possibly do so, do it early in the morning or on a cool day.

Recently I undertook some experimental work in feeding Gambusia at night. The purpose of the experiment was to determine whether or not the minnows work at night. It was found that the working day for Gambusia is necessarily limited to about 12 hours, for they can not find the wiggle tails at night. The fish in the exhibition hall are some that were in captivity all summer and they are well trained, but they can not find the wiggle tails in the dark. They work by the electric light, but if the light is turned out and mosquito larvæ are introduced they are not consumed until the light is again turned on.

A test was made of the possibility of overstocking a pond with Gambusia in which unsatisfactory mosquito control prevailed because of the presence of vegetation that furnished protection for the larvæ against the fish already present. A pond about one-fourth acre in extent, which appeared to be well stocked with minnows, but which contained a marginal growth of " silver-leaf grass " (*Hyrochloa carolinensis*) and a dense bottom growth of *Chara fragilis* and *Potomageton diversifolius* was selected. The Potomageton, especially during the later part of the summer, came to the surface and provided excellent protection for wiggle-tails. The location of the pond was such that heavy mosquito production might reasonably be expected, for it was situated in a pasture where cattle were present day and night. A pigpen was only a few hundred yards away, and a short distance beyond the pigpen were several huts occupied by negroes. It therefore is evident from the types of vegetation present and the proximity of the pond to an easily available blood supply that heavy mosquito breeding quite certainly took place and that the control of production by the use of fish was difficult. If, however, by the further introduction of many Gambusia the competition for food for the fish could be so increased that the larvæ and pupæ hiding among the plants would be sought out and destroyed, the experiment would furnish evidence that when top minnows are sufficiently abundant mosquito control could generally be expected. In order to obtain a check on the effect of introducing more Gambusia, a dam was built across the pond, dividing it into two about equal parts. One section was heavily stocked with Gambusia and the other left as it was for the "control." After the experiment was started and a considerable number of fish had been added to one section the dam broke, permitting the fish to distribute themselves at will over both sections. This no doubt had an effect on the final results. The dam was rebuilt and approximately 18,000 Gambusia were added to one of the divisions. Complete mosquito control was not obtained, but 30 dips, made each week at definitely marked stations in each division of the pond, constantly yielded fewer immature mosquitoes from the section in which the concentration of minnows had taken place. The apparent reduction for all mosquitoes, for the period beginning August 9 and ending November 9, was 30 per cent. For Anopheles the reduction was 13+ per cent, and for all other mosquitoes it was 46+ per cent.

An attempt to determine the proportion of wiggle-tails found where top minnows are present, which permanently escape the fish and reach the winged stage was made. This is important to know but obviously difficult to determine. I used a crude apparatus, but it was in part successful. A floating trap, built of laths over which cheese cloth was stretched, was constructed. This trap, or canopy, covered approximately 40 square feet of water surface. It was light in weight and the lath frame nowhere sank over an inch or an inch and a half below the surface of the water. This permitted the fish to go back and forth under the net without much of an obstruction. The mosquitoes which emerged from the aquatic stages, however, could not get away. A resting place for them was made by hanging a small black box inside of the trap in which, or on which, the mosquitoes were captured with the chloroform tube. The net always was placed over an area where wiggle-tails were most common. In other words, the particular area of a pond where the heaviest mosquito production in the presence of the minnows appeared to be taking place was selected and covered with the net. The net was visited daily and the mosquitoes which had hatched underneath it were removed. This experiment was started on July 30 and it was discontinued on November 5. By actual count 30 Anopheles and 50 other mosquitoes were taken out and 8 mosquitoes escaped from the net before a determination as to whether they were Anopheline or Culecine mosquitoes was made. A comparatively small number, judging from the rather numerous wiggle-tails which were present in the area covered, therefore appear to have escaped the fish. The experiment indicates that a considerable thinning out of larvæ took place in the covered areas through the vigilance of the fish.

Incidentally I learned from this experiment that mosquito larvæ migrate from one section of a pond to another. You probably have long ago known this, but it was new to me. When we covered a certain area of a pond with the net, making it inaccessible to the ovipositing mosquitoes, it was expected that the larvæ present in the vegetation at the time would in part be destroyed by the minnows and in part hatch out, and that in due course of time no wiggle-tails would remain in that particular area. The net, however, was left in one place for over a month, adult mosquitoes were removed from time to time, as described, yet the wiggle-tails appeared to be as common as ever.

Mr. Le Prince. Will you go into that a little more in detail? Do you mean they go underneath from outside?

Mr. Hildebrand. Exactly. It, of course, was necessary to lift the net occasionally to dry it, but this always was done in the daytime.

Mr. Le Prince. I understand the net was put out every night, but was the net in a fixed place? What I want you to explain is how the larvæ got under the net.

Mr. Hildebrand. The net was held in a fixed place by stakes, one at each corner. The larvæ either had to migrate to the area in the daytime when the net was removed for drying or they had to enter by passing under the laths of the net at night.

Mr. Le Prince. The slats were underneath the surface?

Mr. Hildebrand. Yes, they were from about half an inch to an inch and a half below the surface. During the days when the net was taken up to dry there of course was no obstruction present.

The experiments which served to cast the most light upon the problem of the effectiveness of Gambusia as an agent for the control of the mosquito probably constitute the most important part of the summer's work. In these experiments all fish were killed through the application of copper sulphate, in certain ponds that had been under observation for some time. I therefore knew approximately what degree of control prevailed. Similar ponds near or alongside the former, which also had been inspected previously, were let undisturbed and served as a "control." The amount of copper sulphate necessary to kill most fish is given in the Twenty-second Biennial Report of the State Fish and Game Commissioner of the State of Vermont, 1914, pages 74 to 76, as 12 pounds to a million gallons of water, but the author states that 20 to 30 pounds of the chemical per million gallons of water is probably a safer solution to use, as one can not know all the variations in depth in a body of water nor the spring holes which may be present. I found that it was necessary to use even more than 30 pounds of copper sulphate per million gallons of water to get the desired results.

We have been told that fish and frogs rain out of the skies. I almost came to the conclusion that it rained Gambusia several times during the past summer, for I had an immense amount of trouble in keeping the fish out of the waters in which they supposedly had been killed. In a few instances no top minnows were seen for a week or longer after the application of the chemical, and then suddenly they reappeared. In two different ponds three applications of copper sulphate were made without permanently eliminating all minnows. In other ponds one application was sufficient. It, of course, is possible that an underground passageway was used by the minnows in some of the instances. Another possibility is that the ponds contained springs, or "boils," over which the fish hovered and thus escaped the poisonous chemical. Gambusia, however, was the only fish which was noticed in any of the ponds treated after the first application of the chemical.

The results obtained from these experiments are very interesting. Ponds which had various types of vegetation were selected with the view of determining which types were the most favorable for mosquito production. One hundred per cent mosquito control did not prevail throughout the season in any of the ponds used for the "control," but mosquito production was evidently kept quite low. On the other hand, a surprisingly heavy mosquito production took place—a much more prolific production than I had anticipated—in the ponds in which the fish had been killed. Weekly dippings were made at definitely marked stations in each pond. I will give you the figures of the catches made during a few of the weekly dippings. These figures will aid in showing the difference in the rate of mosquito production which was taking place in the treated ponds and in the untreated ones. On September 17, in 24 dips, in one of the copper sulphate treated ponds, 146 Anopheles larvæ and pupæ and 164 larvæ and pupæ of other mosquitoes were taken. The control pond, in an equal number of dips, yielded 23 Anopheles and 16 other mosquitoes. On October 1, in the same pair of ponds and in the same number of dips, 149 Anopheles and 385 other mosquitoes were taken in the treated pond and 29 Anopheles and 34 other mosquitoes in the control. Eight times as many immature mosquitoes were taken in the treated pond as in the control during the period extending from August 27 to October 1. For this experiment a pond supporting a rather dense growth of Myriophyllum was selected. It was divided into two sections and the part containing the most and best protection for mosquito larvæ was left for the fish to control. Complete mosquito control, because of the presence of the Myriophyllum in the control, of course, could not be expected. In another pair of ponds, in which fewer barriers were present, the treated pond yielded nine times as many immature mosquitoes as the control in weekly dippings extending over a period of approximately three months.

I wish to mention two points which are important in making a comparison of the rate of mosquito production taking place in the treated and untreated ponds by the use of the figures obtained from the weekly dippings. First, the dips were all made where the best protection for wiggletails was present. In the control the wigglers were not all in the vegetation where the dips were made, for they could be seen quite generally all over the pond, even in open water. Consequently, a smaller number of immature mosquitoes, in proportion to the number actually present, was taken in the treated ponds then in the control. Second, it is only reasonable to assume that many of the wiggletails present in the control ponds were destroyed by the fish before the winged stage was reached, while in the treated ponds, with the chief enemy, Gambusia, removed, a relatively much larger number arrived safely at the adult stage. The figures therefore do not give the true status of mosquito production in the pairs of ponds considered, yet they appear to be of considerable help in arriving at a sane evaluation of Gambusia as an agent for the control of mosquito production.

An attempt was made to gain information concerning the effect of removing vegetation from ponds. A pond that had a dense marginal growth of "Silver-leaf grass," *Hyrochloa carolinensis*, which varied in width from a few inches to 5 or 6 feet, was selected for the experiment. Certain sections of this pond were cleared in a rough way, i. e., the grass was only partly removed. This clearing was done in sections of 15 to 20 feet. Thereafter a similar section was left undisturbed. The cleared and uncleared sections followed alternately around the pond. We made a rough job of the clearing, because I had noticed that mosquito larvæ were more abundant in the scattered or low grass than in the dense and somewhat taller grass. In fact, it was this observation that led me to undertake the experiment. From September 7 to October 14, 181 Anopheline and 229 Culecine larvæ and pupæ were taken in weekly dippings from the partially cleaned areas, while the undisturbed areas during the same length of time and in an equal number of weekly dippings yielded only 22 Anopheline and 32 Culecine mosquitoes. These results were obtained from a single experiment in which only one type of vegetation occurred. I therefore do not know that the results are generally applicable, but the difference brought about by the partial removal of the grass in this instance apparently is great, and it furnishes a warning that if we undertake cleaning that we had better do it thoroughly.

I think that many of us have made a mistake in assuming, or believing, that it was the dense vegetation which could not be readily penetrated by the minnows that furnished the most effective protection. I think that we must modify this assumption, or belief, at least with respect to silver-leaf grass. It is not the dense grass that affords the best protection for wiggletails, as it grows somewhat taller, lifting many of the blades above the surface of the water, but the scattered grass does not appear to grow tall, and it has many more blades partly or slightly submerged. I think that therein lies the reason for the apparently large increase in mosquito production brought about by partly removing the grass. The grass, of course, soon grew up again and a noticeable decline in the number of wiggletails became evident. Thereupon we again removed some of the grass from the densest areas. On September 22, just before the second cleaning, only 17 Anopheline and 25 Culecine larvæ were taken in 24 dips in the previously cleared areas. On September 28, a week after the second cleaning, we took 54 Anopheline and 91 Culecine larvæ and pupæ. I repeat that these results were obtained from only a single experiment, conducted in a comparatively small pond, supporting only silver-leaf grass, and that the results are probably not applicable to all ponds and quite certainly not to all types of vegetation. The matter, however, seems worthy of further investigation. The indications, at least with respect to " silver-leaf " grass, are that if cleaning is undertaken it must not only be thoroughly done but the operation must be repeated as soon as the green blades against appear at the surface of the water.

In conclusion, I wish again to refer to the effect of the location of a pond, with respect to its proximity to a blood supply, upon the rate of mosquito production. I have already mentioned the rather heavy mosquito production which took place in a certain pond well stocked with Gambusia, but situated in a dairy pasture, near pigpens, and also near the huts occupied by negroes. This pond contained less vegetation favorable for furnishing effective hiding places for the immature mosquito than certain ponds farther removed from a supply of blood, but in the latter very few wiggletails were found in dippings made in the most favorable places. The fish were about equally abundant in all of the ponds here compared. Also, no difference with respect to other foods for the minnows which might have caused them to neglect the wiggletails more in one pond than in the other were detected. It furthermore was noticed that mosquito production was much less prolific, after the fish were destroyed in a body of water, if this pond was far removed from a blood supply than if the pond was near a readily available supply of blood. These observations indicate that in accomplishing mosquito control by the use of top minnows the location of a body of water with respect to its nearness to easily obtainable blood is an important factor.

Mr. Le Prince. The next paper, "Legal phases of malaria control," will be read by Mr. Lathrope, malaria division of the State Board of Health of Arkansas.

LEGAL PHASES OF MALARIA-CONTROL WORK IN ARKANSAS CITIES.

RANDOLPH P. HAMBY.

Mayor of Prescott, Ark.

The authority, if any, of an Arkansas municipality to place a ban upon malaria-carrying mosquitoes and destroy their breeding places is derived from the police power to declare and abate nuisances. The right of the city to require the draining of premises of stagnant water is statutory (C. & M. Digest, sec. 7535).

Among the many erroneous ideas prevalent one is that a city by ordinance or resolution may declare any and all things objectionable to the aldermen to be a nuisance and forthwith abate same. A review of the decisions of the supreme court will reveal instances where city aldermen in their zeal to rid their corporation of annoyances have overstepped their authority and have undertaken to call that a nuisance which in fact is not.

Doubtless every layman who has felt the sting of the bee would think that any swarm of this insect of the order Hymenoptera and superfamily Apoidæ is a nuisance and that the "city fathers" not only have the authority, but it is their solemn duty, to legislate against the abode of the bee in the city. Yet our highest court has said (Arkadelphia *v.* Clark, 52 Ark. 23) "neither the keeping, owning, or raising of bees is in itself a nuisance. Bees may become a nuisance in a city, but whether they are so or not is a question to be judicially determined in each case."

Recently, however, the same court has upheld an ordinance (Merrill *v.* City of Van Buren, 125 Ark. 254) declaring the running at large of chickens a nuisance. Our able chief justice dissented from that opinion, chiefly on the ground that the decision puts unrestrained chickens in a class with a jackass. As far back as 1901 (Ex parte Foote, 70 Ark. 12) our appellate court expressed its opinion of Mr. Jackass in no uncertain language, upholding a conviction for the keeping of one in the town of Wynne, saying, in part, "He has a loud, discordant bray, and, as counsel says, frequently makes himself heard regardless of hearers, occasions, or solemnities; he is not a desirable neighbor; the purpose for which he is kept, his frequent and discordant brays, and the association connected with him bring the keeping of him in a populous city or town within the legal notion of a nuisance."

Then what of Mr. Mosquito, or, rather, Mrs. Mosquito; for are we not taught it is she only "who leaves festers in her trail and, being the female of the species, is more deadly than the male"? Is she a nuisance? Can legal action be taken to destroy her breeding places, wherever found? Does Mrs. Anopheles occupy the same position in our society as does Mrs. Bee, or should she be relegated to the class occupied by the unrestrained chicken and the jackass? So far as the writer is advised, the mosquito family has not appeared before our supreme court for a judicial determination of its social status.

In speaking of police powers and regulations of cities and towns the statute (C. & M. Digest, 7529) provides:

> They shall have power to prevent injury or annoyance within the limits of the corporation from anything dangerous, offensive, or unhealthy, and to cause any nuisance to be abated * * *.

And this authority extends for 1 mile without the corporate limits. The city board of health (C. & M. Digest, 7593) is invested with power and has imposed upon it such duties as shall be necessary to secure the city and the inhabitants thereof from the evils of contagious and malignant and infectious diseases.

The court, in Foote ex parte, above referred to, in speaking of nuisances, said:

> There are two kinds of public nuisances. One is that class of aggravated wrongs or injuries which affect the morality of mankind and are in derogation of public morals and decency, and, being malum in se, are nuisances irrespective of their location and results. The other is that class of acts, exercise of occupations or trades, and *use of property* which become nuisances by reason of their location or surroundings. To constitute a nuisance in the latter class, the act or thing complained of must be in a public place *or so extensive in its consequences* as to have a common effect upon many as distinguished from a few. Where it is in a city or town, where many are congregated and have a right to be, and produces material annoyance, inconvenience, discomfort, or injury to the residents in the vicinity, it is a public nuisance of the latter class.

After a consideration of his habits and the purpose for which he is kept, the male donkey was by the supreme court in Foote ex parte declared to be a nuisance of the latter class above described.

With these decisions and the rules above set out before us, let us study the habits of Mrs. Anopheles and determine to which, if either, class of nuisances she belongs. Her voice, while not exactly discordant, is at least sinister and very annoying, especially in the wee small hours of night; in her flight she covers a large territory and has a common effect upon many, as distinguished from a few; she is a disease carrier; she certainly shakes a wicked antenna; she assuredly produces material annoyance, inconvenience, discomfort, and injury to the residents of the vicinity, and undoubtedly belongs to the latter class of nuisances heretofore mentioned. While probably true—

> That Mister Skeeter, when he rests upon the leg of man,
> Does but little damage, for he's an "also ran"—

his habits and close association with his mate, "The Madame," places him beyond the pale of civilization, and his doom also is sealed because of his propagative proclivities.

So, undoubtedly, cities and towns in Arkansas have the legal as well as moral right to wage war on all dipterous insects of the family Culicidæ, especially the Anopheles type, and they have ample authority to make all reasonable necessary regulations for the destruction of breeding places and to provide a punishment for the citizen who negligently permits this pestiferous insect to breed upon his or her premises.

Mr. LATHROPE. In this connection it is rather interesting to state that in Birmingham, Ala., about 1912, the water company there was sued by a number of farmers who lived near a lake which was formed by a large dam which the water company had constructed about 20 miles from the city. The farmers claimed that after the dam had been built serious mosquito nuisances had been created.

Just what the results of this lawsuit were I am unable to say. Possibly some of the Alabama men may know whether the farmers were paid for their trouble or whether the water company won the suit.

DISCUSSION.

Mr. LE PRINCE. The legal phase of malaria control is now open for discussion.

Mr. GILBERT. Mr. Chairman and gentlemen, Mayor Hamby, the author of the paper you have just heard, is mayor of one of our towns that has just completed a most successful season of malaria-control work. He has been a very energetic supporter of the work, and as he is a lawyer I believe he is better posted on the question of malaria control from the legal standpoint than any other man with whom I have come in contact. There are a few points in the conduct of the recent malaria-control campaign at Prescott that I wish to bring out. I might say, to paraphrase Kipling, that I learned about towns from her.

A city ordinance made the existence of breeding places on one's property a misdemeanor punishable by fine. Mayor Hamby was very energetic in enforcing this ordinance. He has haled before him and fined in the vicinity of 100 offenders for violation of this ordinance. It is interesting to note that only about 5 per cent of these were Negroes. Inasmuch as this is the only town in Arkansas where this has been done to this degree, the effects are worthy of consideration. One of these effects (and this was the one most desired) was that people knew the inspector was coming around, and they were careful to have no breeding places on their properties. Then, again, it worked the other way: In several cases people reported, after having made an inspection of their own property, that mosquitoes were breeding in the neighborhood. The inspector went around and found breeding on their own property and they were fined. The next time they were reluctant to report. Furthermore, the funds for carrying on the work were raised by popular subscription and a man did not feel like contributing to the fund after he had been fined.

Mayor Hamby believes, and his conception, as I understand it, is based on his interpretation of the laws of Arkansas, that the police powers of an incorporated community extend outside of the corporate limits in health matters. If such as the case, a community can control the breeding within the flight range of her borders. This will probably be tried out next year.

Mr. Le Prince. Would Doctor Carter care to make any remarks?

Doctor Carter. Only this one. In both Panama and in Habana we met the difficulty of fining a man for reporting his own delinquency in this way: We didn't think the sanitary department wished to make money by collecting fines, but to get rid of breeding places, so in all cases a suspended sentence was put on, and if the man removed the breeding place within 24 hours the fine was suspended, and if he didn't it was finally put on.

Mr. Le Prince. The next paper on the program will be "Tidegate operations," by Mr. Old.

TIDE-GATE OPERATIONS AT SAVANNAH, GA.

H. N. OLD.

Assistant Sanitary Engineer, United States Public Health Service.

As the majority of the control area at Savannah is abandoned rice-field land, nearly all of which is from 3 to 4 feet below mean high tide, one readily realizes the importance of proper tide-gate operation. In fact, the success or failure of malaria-control measures in the Savannah zone is almost wholly dependent upon the efficiency of operation of these gates.

Draining the Savannah control area of approximately 10 square miles, in addition to a large area in the county outside of the control zone, are five main canals having their outlets to the Savannah River protected by five gates, three of which are of the wooden timber hinged type, one bolt-and-strap hinged iron flap gate, and one large double-door iron gate.

In addition to these main canals are four smaller feeder canals, each provided with a wooden timber-hinged gate at the point of discharge to the main canal.

Four of the wooden gates were installed in 1920 during the first year of malaria-control work, and all have operated very satisfactorily in so far as the mechanical construction is concerned, although at times they have been rendered inefficient by reason of large pieces of floatage lodging in them.

The dikes and fills over the trunks and the trunks themselves in connection with these four gates have given very little trouble this year, only small adjustments being necessary from time to time in order to insure better and tighter closing of the gate.

Detailed description of the installation of these gates was given at the Louisville conference last November by Mr. Davis, who supervised the work in Savannah last year.

The other three wooden gates are installations of several years ago and have necessitated considerably more attention, but in view of the length of service can be said to have given very fair satisfaction.

At the outlet of Bilbo Canal, a large concrete box storm drain, is a bolt-and-strap-hinged iron flap gate, 9½ by 14 feet and weighing about 4,100 pounds. This gate has not been giving as good service as is desired, due chiefly to the fact that its weight retards proper opening on the outgoing tide, thereby holding back storm drainage after heavy rains and even in normal times, also due to one end of the gate being badly sprung, and with the pressure of high tide, which covers the trunk to the depth of 3 feet, a large volume of water forces through this opening. The gate would have been much more readily repaired and adjusted if made in two parts, also proportionately lighter in operation.

Near the outlet of the Ogeechee Canal, draining nearly all the area on the west side of the city, is a large double-door iron gate with doors 12½ by 14 feet, forming an angle of approximately 15 ° when fully closed. This gate was entirely inoperative in the spring of 1920, and the city, I understand, paid $1,400 to have it rehung and placed in what was supposed to have been first-class shape.

However, it has operated this year at very low efficiency, due chiefly to the fact that an immense amount of tide water is allowed to pass before sufficient head is developed to close the doors; and after the doors finally close considerable leakage is found between them and at the hinge sides of the doors.

The balance of the gate has been improved somewhat by the use of counterweights, but closing is not effected until there has been a tide rise of nearly 3 feet, which condition, with the leakage previously mentioned, causes a difference of water level on high tide of only 3 to 3½ feet in front of and in back of the gate.

Inasmuch as this gate is in the nature of a key to all the west side drainage, the city is considering the removal of this gate and the provision of a more effective type of gate, possibly a battery of three 60-inch Calco iron gates attached to Armco iron trunks.

Endeavor has been made this year at Savannah to detail one man to make daily inspections of all tide gates at extreme high and low tides in order to note the effectiveness of operation and to correct any defects, such as dislodging floatage and making adjustments, where necessary.

Unfortunately, this program has not been carried out entirely, so that at times the gates have been stuck and hung open during several tides.

No catch racks have ever been provided for the protection of the gates at Savannah, but it appears highly desirable that some such measure of protection be afforded, thereby insuring better operation and reduced inspection costs.

Mr. Le Prince. The next paper will be "Economic Losses Caused by Malaria," A. W. Fuchs.

ECONOMIC LOSSES FROM MALARIA.

A. W. FUCHS,

Associate Sanitary Engineer, United States Public Health Service.

NOTE.—Figures in parentheses refer to the appended list of references.

The chief surgeon (1) of a southern railway suggests that the economics of malaria control and its accepted advantages should be brought out in this conference. This feature, he believes, will influence authorities in charge of corporations and municipalities more quickly than any other point of view. Sanitation for an industrial corporation must be considered from the economic standpoint, according to Doctor Carter (2), and for every community its economic aspect must be taken into account.

The annual loss to this country from malaria would finance our Navy. In 1909 Howard (3) estimated there were 3,000,000 cases annually in the United States, and the losses through death, cost of medical treatment, losses to enterprises in malarious regions through inefficient labor, and other factors, were at least $100,000,000 a year. In an address before the United States Senate, July 16, 1916, Senator Ransdell (2) placed the loss in 1913 at the astounding sum of $694,907,750. In California alone the economic cost of the disease is estimated at nearly $3,000,000 per annum (4).

In the number of deaths caused either directly or indirectly, the sickness and suffering, the lowered vitality of those afflicted, malaria is without a rival (5). But of even greater moment are the economic losses to the individual suffering with malaria, to industry and agriculture depending on malarial labor, and to the community where malaria prevails.

Losses to individual suffering with malaria.—A case of malaria, particularly an acute attack, involves expenses for doctors' fees, medicine, nursing, loss of time and wages, and sometimes expenses incidental to death. Seldom can these losses be ascertained with precision, but there are available results of a number of investigations bearing on the subject. These are summarized in convenient form in Table I.

Many cases of malaria are never seen by a doctor. At Charleston, Miss. (6), 59 per cent of the cases were attended by physicians, while near the proposed Mitchell Dam, in Alabama (11), the percentage in

1921 was 42. On a plantation near Mound, La., two-thirds of the cases called a doctor in 1914 (10). In highly malarious sections, however, the proportion is much smaller. Bass (9) estimates that for every malaria patient in a certain delta county who calls a doctor there are at least two others who do not. The number of doctors' calls to malarial patients varies from 1.04 per case at Cairo, Ga. (7), in 1920, to 3.43 at Thomasville, Ga. (8), in 1919; and the average for 10 places, in which a total of 1,400 cases were considered, was 2.25. Physicians' fees vary in different sections, and depend also on the distance. In one Mississippi delta county doctors in 1918 estimated $5 as a fair average (9), while at Union City, Tenn., the present scale of fees is $2.50 for a town call and 50 cents additional for each mile outside the city. In Shasta County, Calif. (14), the expense for medical services in 1918 was $7.10 per family, or $3.10 per person, for malaria.

TABLE I.—*Economic losses suffered by an individual with malaria.*

Place.	Year.	Number of cases considered.	Doctor and medicine.				Nursing.		Wages.				Deaths.		Total losses per case.	Reference No.	Source of data.
			Calls per case.	Fee per call.	Medicine per case.	Cost per case.	Time (days).	Cost per case.	Time (lost days).	Per cent cases among workers.	Wages per day.	Loss per case.	Per case.	Loss per case.			
Alabama	1913	7,140								[1] 65						20	Doctors' reports.
Arkansas	1913	18,528								[1] 62						43	Do.
Bamberg, S. C.	1918-1920	1,973													$32.40	24	Malaria census.
Brownsville, Tenn.	1919	75				$27.50						$33.20			60.70	25	Do.
Do.	1920	7				16.50						16.30			32.80	25	Do.
California	1916	25,000													120.00	4	State board of health.
Cairo, Ga	1918	72	2.22			8.40						11.50			19.90	7	Malaria census.
Do.	1919	108	1.86			8.40						20.00			28.40	7	Do.
Do.	1920	54	1.04			4.30						5.60			9.90	7	Do.
Central of Georgia Ry	1919	9			[2] $7.50				11.5							13	Station men.
Chester, S. C.	1918	302				36.00						16.00			52.00	16	Malaria census.
Do.	1919	411				51.50						19.50			71.00	16	Do.
Do.	1920	55				54.50						27.50			82.00	16	Do.
Coosa County, Ala.	1918-1920	181													76.93	11	Hilly farm country.
Crystal City, Mo.	1915	325							6.0							28	Pittsburgh Plate Glass Co
Dallas, Tex.	1916	85							6.87							28	Hospital records.
Do.	1917	4							8.0							28	Do.
Demopolis, Ala.	1918	69	1.96			17.30			38.6		$2.50	94.00			111.00	19	Malaria census.
Do.	1919	194	2.50			16.50			47.6		2.50	119.00			135.00	19	Do.
Do.	1920	12	1.67			8.80			13.8		2.50	34.60			43.40	19	Do.
Dyersburg, Tenn.	1919	17				33.30						77.30				30	Do.
Farmville, N. C.	1919	24							10.8							18	School absences.
Hartsville, S. C.	1918-1920	25													44.20	32	Malaria census.
Lake Village, Ark	1916	21				4.95			12.0		1.50	9.45			14.40	27	Plantation labor.
Mignon, Ala.	1918-1920	235	2.3			1.91						7.46			9.37	22	Malaria census.
Mississippi	1913	34,359								[1] 70			[3] 0.0077			21	Doctors' reports.
Mississippi Delta county	1918			$5.00	2.50											9	Doctor's estimate.
Mound, La.	1914	166					[4] 1.34	2.69	[4] 5.08			10.18			[5] 34.30	10	Plantation labor.
Scott, Ark.	1914	12					3.00		5.50							17	Do.
Shasta County, Calif.	1918				[2] 1.38	[2] 3.10						[2] 4.56			[2] 7.66	14	Irrigation district.
Shelby, Ala.	1918-1920	235	2.3			1.91						7.46			9.37	15	Malaria census.
Thomasville, Ga.	1919	291	3.43			14.30						25.80			40.10	8	Do.
Do.	1920	183	2.80			12.80						6.30			19.10	8	Do.
Trinity County, Tex.	1916	1,600				3.35			20.4			15.60	.0056		18.95	37	Survey of six towns.
Union City, Tenn.	1921			(6)													County fees.

---

[1] Over 15 years of age.
[2] Per resident, not per case.
[3] From State reports for years 1915 to 1920.
[4] Time reduced to "adult days."
[5] Includes loss of 10.7 "adult days," valued at $21.43 per case, due to inefficiency of labor at work while still suffering with malaria
[6] $2.50 in town; 50 cents additional per mile in country.

The sales of quinine and chill tonics in southern towns support many a drug store. At Jacksonville, Tex. (12), over 10 per cent of the prescriptions filled by druggists from March to October, 1919 and 1920, were for malaria. So familiar are inhabitants of malarious districts with the value of quinine and chill tonics containing quinine in the treatment of malaria that vast quantities are purchased without prescription. Manufacturers of chill tonics would not advertise so widely if their sales did not warrant it. It is evident that remedies for malaria constitute a heavy tax on residents of malarious sections. Laborers on the Central of Georgia Railway spend up to $30, and probably average $5 to $10, annually per man for quinine and chill tonics (13). A canvass of residents of an irrigation district of Shasta County, Calif. (14), showed that in 1918 the cost of malaria medicines was $5.70 per family, or $1.38 per person. Bass estimates an expenditure of $2.50 a year for malaria remedies by those who are "home treated" in one of the Delta counties (9).

The combined expenditures for medical service and drugs, as shown in Table I, are reported all the way from $1.91 for each case of malaria at Shelby, Ala. (15), to $54.50 at Chester, S. C. (16), and the average for 19 places, in which a total of over 3,700 cases were investigated, is $17.30 per case.

Nursing a malaria patient frequently involves a loss of time from productive work on the part of other members of the family. This loss is doubtless a considerable one, though few definite statements as to its financial equivalent are available. On a plantation near Scott, Ark. (17), there was an average loss of time in the family for nursing of three days for each attack of malaria during the crop season of 1914. Among the tenants on a large plantation in Louisiana nonmalarial members of families lost 2.32 days in attending each attack, and this time was equivalent to $2.69 in crops which could have been raised (10).

By far the heaviest tax on the individual who has malaria is from loss of time during illness. If the patient is of working age, the loss of wages may be of vital moment to himself and his dependents. If of school age, the loss to the child is not measurable in dollars and cents, but may count for much in a rural schooling that is none too adequate at best, while for the community it means high taxes for schools which are not used to capacity. In the last three months of 1919, 24 children at Farmville, N. C., were absent from school a total of 261 days, or 11 days per child, on account of malaria (18). Elsewhere the amount of time lost by patients has been reported from 5.08 days per case near Mound, La. (10), to as high as 47.6 days at Demopolis, Ala. (19). The average of 12 reports, including 2,500 cases, is 15½ days per case. Von Ezdorf found that in 1913, 62 per cent of malaria patients were over 15 years of age in Arkansas (43). 65 per cent in Alabama (20), and 70 per cent in Mississippi (21. Thus it is evident that a large proportion of cases occurs among adult workers. Reports of the amount of wages lost through sickness from malaria vary from $5.35 per case at Mignon, Ala. (22), to $119 at Demopolis, Ala. (19), and average $28 per case for a total of over 3,900 cases in 20 communities.

A death from malaria involves a loss not easy to evaluate. Not only does the family bear the funeral expenses, but both family and community are robbed of the deceased's earning capacity. On the basis of damage claims awarded by the law courts, sanitarians frequently figure $5,000 as the loss resulting from each death. The mortality rate in malaria is 1 in 100 to 200 cases (5). The loss from this cause may therefore be considered between $25 and $50 for each case of malaria.

Summing up the average losses sustained by the individual from the causes mentioned above, gives a total of $82 for the average case of malaria. Actual losses are reported (see Table I) from $9.37 per case at Shelby, Ala. (15), to $135 at Demopolis, Ala. (19). The average loss reported from 23 places, where a total of over 31,000 cases were considered, is $44, but most of these inquiries failed to include all the causes of loss considered above.

Losses to industry and agriculture.—Serious as they are, the losses suffered by individuals sick with malaria are of less significance than those sustained by industry and agriculture in the South. To such enterprises malaria spells inefficient labor, a costly labor turnover, a scarcity of labor often when most needed, with a consequent curtailment of production or of crops and an expensive idleness of machinery or of farm lands. The money equivalent of these losses may not always be ascertainable, but they exist nevertheless.

Probably the heaviest tax imposed by malaria is from inefficient labor. Hands that receive full pay while working with only a feeble effort place a burden upon manufacturer, railroad, and plantation owner alike. Just as soon as the acute attack is over his financial stress urges the patient back to work. Prior to the inauguration of malaria-control measures at Roanoke Rapids, N. C., the cotton-mill managers estimated the efficiency of their employees at from 40 to 60 per cent during the four malaria months (29). The Burton-Swartz Cypress Co., Perry, Fla., referring to its antimalaria work, states (39):

> In our opinion, the efforts and expenses are fully justified in the increased labor efficiency, and we anticipate keeping up our program as long as we are here. We would strongly advise every mill in the country to do the same thing.

The following quotation is from a letter recently received from the general manager of the Longville Lumber Co., Longville, La., where malaria-control work is being conducted (26):

> The writer has held for years that one of the greatest assets of a manufacturing business is the health of the crew; that you can not make any money with a man when he is sick, therefore keep him well; that you can not make as much money with a man when his family is sick, because you do not have his thoughts and attention on the work, as it is occupied with considering the condition of his family, therefore keep his family well, and to that end we provide every safeguard that we know of.

Howard estimates that one-fourth of the productive capacity of an individual, suffering with an average case of malaria, is lost. On this basis, and using the current price of cotton, Van Dine (10) calculated a loss in time of 10.7 "adult days," valued at $21.43, for each case of malaria from inefficiency of labor on a plantation near Mound, La., in 1914.

There is a labor turnover many times during the season caused by malaria-infected workers leaving mill and farm when they become too sick to work. This situation becomes serious where new labor must be trained in skilled or semiskilled work. One of the largest corporations on the Cotton Belt Railway has discovered, according to Van Hovenberg (23), that it costs them an average of $300 for each new employee added to the force. The results are uncertain labor, slower completion of a job, and work of poor quality, because experienced men are replaced by inexperienced. At Roanoke Rapids, N. C., the health officer estimated that as a result of the excessive prevalence of malaria 50 per cent of the cotton mill population were transients prior to 1914. Mills were operating shorthanded much of the time. In 1914, when malaria-control work was undertaken, the population increased by 500 and was more permanent (40).

By sapping efficiency and increasing labor turnover malaria reduces the amount of effective labor available. In Louisiana (10)—and this is true of the entire malaria belt—the time lost through malaria during at least four months of the year falls at a period when there is a deficiency of labor and when the demands of the crops for labor is greatest. On a plantation in Arkansas there was a loss of time of 102 days during the crop season from malaria (17). Because of the seasonal flow of labor from farm to factory in rural sections of the South, this scarcity of labor is felt by mills, which must either shut down or operate below normal capacity during the malaria season. As a result of antimalaria work, the San Augustine Lumber Co., at Keltys, Tex., shipped 20 per cent more lumber in 1917 than ever before, resulting in $30,000 increased freight revenue to the Cotton Belt Railway (23). Mr. E. L. Kurth, secretary and treasurer, stated that if there had been the same amount of sickness in 1917 as in 1916 the mill would have been closed down probably one-half the time. Similarly, Mr. A. Treischman (27), of the Crossett Lumber Co., Arkansas, writes concerning the antimalaria campaign in 1917:

> Our pay roll and hospital records show a large number of employees who were idle on account of sickness, principally due to malaria, whereas during the past 12 months there has been practically no shortage of labor. If in addition to the unusual demands upon our men (for military service) we were further handicapped by the usual amount of sickness, our production would have been decreased at least 33 per cent.

A large sawmill and box factory at Kress, Va., declared (31) that "the work done here two years ago (1916) was worth $35,000 per annum to us for the past two years." Within a 25 square mile rural area in Mitchell County, Ga., containing 81 families who had under cultivation 3,967 acres of land, the loss on account of malaria in 1918, through inability to cultivate and gather crops, doctors' and medicine bills, totaled $46,520; but in the following year, 1919, during which quinine was administered systematically, the loss in the same area was only $5,950, while in a similar adjacent area the losses were even greater than in 1918 (33). These and similar instances of the economic handicap imposed by malaria upon industry and agriculture are summarized below:

TABLE II.—*Economic losses to industry and agriculture from malaria.*

Place.	Character of place.	Year.	Losses.				Reference.
			Item.	Total.	Per acre.	Per family.	
Cotton Belt Railway.		1917-1920	Hospital costs [1]	$140,300			2
Crossett, Ark	Lumber mill	1917	Production [1]	[2] 33			27
Keltys, Tex	do	1917	do	20			23
			Revenue for railroad.[1]	$30,000			23
Kress, Va	Sawmill and box factory.	1917	Output [1]	$35,000			31
		1918	do[1]	$35,000			31
Lake Village, Ark	Plantations	1916	Medical bills and time.	$303		$11.21	34
Mitchell County, Ga.	Agricultural	1918	Medical bills and crops.	$46,520	$11.50	574.00	33
Mound, La	Plantation	1914	Crops uncultivated.	$6,520	3.62	88.00	10
Shasta County, Calif.	Irrigation district.	1918	Medical bills and time.	$10,000		31.70	14
Do	do	1918	Property values	$250,000	7.80		14
Roanoke Rapids, N. C.	Cotton mill	1914	Labor efficiency [1]	[2] 50			28
			Freight revenue [1]	32			35

[1] Losses prevented, or gains effected, by antimalaria work.

[2] Per cent.

Losses to community from malaria.—The reduction of individual earning and spending capacity, of agricultural and industrial production, affects the prosperity of the entire community—the merchant, the landowner, the railroad. Where malaria seriously prevails it does more injury to the community than any other disease; indeed, more than all others combined. No such community is or can be prosperous, says Doctor Carter (2); certainly no white community. The market value of land, whether for suburban homes, summer resorts, manufacturing sites, or farms, remains low. Industries are not established, agricultural settlements are not made, farms are abandoned, and enterprising persons move to a more favorable locality.

Instances of such conditions are numerous. Talladega Springs, near the pool of Lock 12, Coosa River, Ala., was a summer and health resort. In 1915, when Doctor Carter was there, "the hotel closed in early September. It ceased to be profitable as a health resort, probably 70 per cent of the people having malarial fever that year (31)." Swamp sections containing fertile soil and capable of the highest agricultural production are largely undeveloped. With the introduction of major agricultural drainage and subsidiary antimalaria work, thousands of acres have been, and millions will be, released from the scourge at comparatively little expense. Within a short time after the draining of a swamp at Humboldt, Tenn., as an antimalaria measure the landowners had the timber cut and the land plowed up ready for cultivation. Bass (9) believes that if any Delta county could eradicate malaria so as to be able truthfully to say to the world that there is no malaria there, the value of the land would be doubled in a short time. In the Mississippi Delta much valuable agricultural land, capable of producing from 1 to 2 bales of cotton per acre, with a net profit of $30 to $90 an acre, and hence a splendid investment at $100 to $300, according to Doctor Leathers (5), is to-day being bought for from $20 to $40 per acre. Moreover, it is not being populated, chiefly because of the high incidence of chills and fever.

The same is true of the eastern shore of Virginia, the Everglades of Florida, and many sections of the Southern States. Doctor Carter (36) mentions one place where power from a hydroelectric plant was abundant and very cheap and where the manager told how a number of options for cotton mills, wagon factories, etc., had been abandoned because of the prevalence of malaria. Another deal involving the purchase of a half million dollar tract of land in eastern North Carolina for agricultural colonization was never consummated on account of the presence of malaria (36). On the basis of the malarial fever caused by the formation of the pool of Lock 12, Coosa River, Ala., suits for damages were brought approximating a half million dollars; and Doctor Carter saw a large number of farmhouses and small farms in this neighborhood abandoned, malaria being given as the cause (31). Similar conditions prevailed on the pool of Lock 17, Black Warrior River. At Wilson, Va., an agricultural community, there was an almost complete loss of crops in 1914, and some farmers moved away, leaving their lands idle, as no one would rent them. Doctor Carter (31) thinks the majority would have done so but for a promise that malaria would be controlled the next year.

The same authority (31) points out that the gravest injury from malaria is not by these sudden increases, spectacular as they are, but by its continuous and increasing prevalence in communities, sapping their strength and energy. On the peninsula of Virginia the land is good, markets convenient, cultivated communities close and easily accessible, and agriculture in Virginia as a rule is prosperous; but people can not work and will not live where malaria seriously and continuously prevails, and they have gradually abandoned this section. The loss in value of these lands he hesitates to estimate—certainly over $30 an acre.

Malaria control profitable.—Only ignorance of the serious handicaps imposed by malaria and the ease with which they can be profitably overcome stands in the way. In nearly 100 communities undertaking malaria-control work in the last few years, the average cost the first year was about 80 cents per person, or a little over $1 per acre. The annual cost of maintaining the work in these towns after the first year averaged 20 cents per person, or 35 cents per acre. As a result of these modest expenditures, the incidence of malaria has been reduced 75 to 95 per cent in these communities. Insurance claims paid for reason of disability from malaria among mill hands at the Pittsburg Plate-Glass Co., Crystal City, Mo., dropped from $230 in 1915 to $61 in 1916, following control work (28). That money spent for antimalaria work is an investment, not an expenditure, and a profitable investment at that, is shown in the following tabulation. Profits of from 73 per cent up to over 1,000 per cent are reported.

TABLE III.—*Profits on investment in malaria control.*

Place.	Year.	Saving due to control.			Cost of control work.	Profit on investment.	Reference.
		Cases prevented.	Loss per case.	Losses prevented.			
						Per ct.	
Brownsville, Tenn.	1920	81	....	$3,193	$1,848	73	25
Cairo, Ga.	1920	54	....	2,523	856	195	7
Chester, S. C.	1920	356	....	24,700	8,719	183	16
Cotton Belt Railway	1917–1920	1,403	$100	140,300	42,000	233	2
Demopolis, Ala.	1920	182	....	25,724	3,009	757	19
Goldsboro, N. C.	1920	810	50	20,250	10,052	102	18
Mitchell County, Ga.	1919	....	....	40,570	3,580	1,030	33
Thomasville, Ga.	1920	182	....	25,724	3,000	757	8

Where control work has been undertaken, business men, physicians, and city officials alike have enthusiastically indorsed it. A number of opinions have already been cited. The first systematic antimalaria work undertaken in the United States was at Roanoke Rapids, N. C., in 1913. After two years' experience here, S. F. Patterson, treasurer of the Roanoke Cotton Mills Co., states (40):

> The money spent in antimalaria work here has paid the quickest and most enormous dividends I have ever seen from any investment, and after having had our experience I would, if necessary, do the work over again if I knew it would cost 10 times the amount. * * * Our experience has taught us that the eradication of mosquitoes is not only the proper thing to do from a strictly health standpoint, but it is an exceedingly profitable thing to do.

Commenting on the control campaign at Humboldt, Tenn., in 1921, C. W. Rooks, secretary of the local business men's club, writes (41):

> 'Humboldt throughout its history has been malarious; in fact, the disease has been more or less a scourge to the town. * * * The campaign you put on has eliminated these conditions. * * * You have convinced our people that the mosquito and malaria can be controlled, and the club is already laying plans for next year's campaign.

One of the doctors in the same town declared: "In view of my reduced practice, the $15 I contributed to the antimalaria campaign was the worst investment I ever made (42)."

Mayor F. L. Pittman, of Union City, Tenn., made the following statement regarding the work in 1921 (29):

> There could not have been a better camapign for any purpose than this one, and the money spent was the best investment we have made during my régime. We want to urge our successors to keep this good work going.

At West Point, Va., Griffitts reports the mayor was reelected in 1920 on an antimalaria plank.

Secretary Hoover recently started a movement to increase the productive power of the Nation by the elimination of waste in industry (38). Following this lead, we must make the economic importance of the malaria problem plain to business men's clubs and farmers' organizations. They will do the rest; town and county officials will follow suit.

REFERENCES.

(1) Craig Barrow, letter to J. A. Le Prince, August 29, 1921.[1]

(2) H. W. Van Hovenberg, Malaria control on the St. Louis-Southwestern Railway Lines, 1917–1920.

(3) L. O. Howard, Bulletin No. 78, United States Bureau of Entomology, 1909, Economic loss through insects that carry disease.

(4) F. L. Hoffman, Malaria problem in peace and war, 1918.

(5) W. S. Leathers, The importance of malaria from a public-health and economic standpoint. Southern Medical Journal, August, 1918.

---

[1] Copy filed at headquarters of field investigations of malaria, United States Public Health Service.

(6) J. L. Clarke, report on Charleston, Miss., 1920.[1]

(7) H. N. Old, report on Cairo, Ga., January 7, 1921.[1]

(8) H. N. Old, report on Thomasville, Ga., January 7, 1921.[1]

(9) C. C. Bass, discussion of reference (5).

(10) D. L. Van Dine, Scientific Monthly, November, 1916.

(11) Ferguson and Johnson, Alabama State Board of Health, report on Survey of Coosa and Chilton Counties, September 14, 1921.[1]

(12) G. Parker, report on Jacksonville, Tex., 1920.[1]

(13) A. F. Allen, report to chief surgeon, Central of Georgia Railway, November 28, 1919.[1]

(14) H. F. Gray, Cost of malaria: A study of economic losses, etc. J. A. M. A., May 24, 1919.

(15) E. B. Johnson, report on Shelby, Ala., 1920.[1]

(16) L. M. Fisher, report on Chester, S. C., June, 1921.[1]

(17) J. K. Thibault, jr., A cooperative study of the losses to rural industries from malarial mosquitoes. Southern Medical Journal, March, 1915.

(18) A. W. Fuchs, Malaria statistics. Transactions Second Antimalaria Conference, Public Health Bulletin 115, January, 1921.

(19) E. B. Johnson, report on Demopolis, Ala., 1920.[1]

(20) R. H. Von Ezdorf, Malaria in Alabama. Reprint 186, Public Health Reports, 1914.

(21) R. H. Von Ezdorf, Malaria in Mississippi. Reprint 193, Public Health Reports, 1914.

(22) E. B. Johnson, report on Mignon, Ala., 1920.[1]

(23) H. W. Van Hovenberg, Malaria and railroad operation. Southern Medical Journal, August, 1918.

(24) L. M. Fisher, report on Bamberg, S. C., June, 1921.[1]

(25) W. G. Stromquist and A. W. Fuchs, reports on Brownsville, Tenn., 1920.[1]

(26) J. W. Martin, general manager, Longville Lumber Co., Longville, La., letter to A. W. Fuchs, October 26, 1921.[1]

(27) Sparks, Derivaux, and Taylor, Malaria-control demonstrations. Reprint 476, Public Health Service Reports, July 12, 1918.

(28) R. C. Derivaux, Some results of malaria control, etc. Southern Medical Journal, August, 1918.

(29) F. L. Pittman, mayor of Union City, Tenn., letter to A. W. Fuchs, November 3, 1921.[1]

(30) A. W. Fuchs, report on Dyersburg, Tenn., March 21, 1921.[1]

(31) H. R. Carter, letter to A. W. Fuchs, October 12, 1921.[1]

(32) L. M. Fisher, report on Hartsville, S. C., June, 1921.[1]

(33) Ethel Barrier, report of investigations in Mitchell County, Ga., 1920.[1]

(34) Derivaux, Taylor, and Haas, Malaria control. Public Health Bulletin 88, September, 1917.

(35) H. W. Van Hovenberg, Railway Age, July 5, 1919.

(36) H. R. Carter. The malaria problem of the South. Transactions First Antimalaria Conference, Public Health Bulletin 104, October, 1919.

(37) Texas State Board of Health, report of survey of Trinity County, 1916.[1]

(38) Herbert Hoover, Taking up the slack in industry. Eng. News-Record, February 24, 1921.

(39) A. T. Gerrans, Burton-Swartz Cypress Co., Perry, Fla., letter to A. W. Fuchs, September 24, 1921.[1]

(40) R. H. Von Ezdorf, Demonstrations of malaria control. Reprint 328, Public Health Reports, March 10, 1916.

(41) C. W. Rooks, secretary Business Men's Club, Humboldt, Tenn., letter to A. W. Fuchs, October 19, 1921.[1]

(42) A. W. Fuchs, report on Humboldt, Tenn., 1921.[1]

(43) R. H. Von Ezdorf, Malaria in Arkansas. Reprint 160, Public Health Reports, 1914.

DISCUSSION.

Mr. Le Prince. May I ask Doctor Boyd to open the discussion?

Doctor Boyd. Mr. Chairman and gentlemen, Mr. Fuchs's very excellent paper leaves very little to be said:

In my own experience in making a survey it was the original intention to collect data on the economic losses caused by malaria. I found great difficulty in getting any sort of information that would enable me to closely estimate the losses which were experienced. I think one factor that may influence the loss that a community experiences from malaria depends upon the relative incidence of tertian fever compared with estivo-automnal fever. In southeastern Missouri it appears that the tertian fever is responsible for about four-fifths of the cases of malaria. Of these cases, only from 25 to 35 per cent, roughly speaking, have consulted a physician. Many have not received any form of treatment. This is more particularly true in the case of children than it is in the case of adults. Very seldom does the individual ill from tertian fever lose time from his work other than that lost during the actual chill. In the intervals between chills he goes to his work, and in a considerable portion of the cases he is undertaking to work during the chill. Of course it is to be recognized that a physical impairment exists, but nevertheless the loss in his working efficiency is exceedingly difficult to estimate. So far as I can judge from what I have seen, I wouldn't believe that the cash loss by reason of out-of-pocket expenditures because of malaria very much exceeds $2.50 per patient.

Mr. Old. The average days lost per case of malaria on two divisions of the Central of Georgia Railroad this year has averaged, on one, 7.1; on the other division, 7.26.

Mr. Le Prince. We should like to hear from Doctor Fricks.

Doctor Fricks. Mr. Chairman, Mr. Fuchs has indicated very clearly the immediate loss in dollars and cents which may result from malaria fever, and I think Doctor Boyd was quite correct in his statement that the actual cash loss may vary considerably. I was extremely surprised when he and Doctor Ziegler told me that in their malaria survey in southeastern Missouri they had found the money loss ran very low; in fact, it was so small they were unable to compute it.

But to my mind, while the immediate loss in dollars and cents from malaria is sometimes enormous, there is another loss, not so tangible perhaps, but greatly in excess of the direct loss. Perhaps I can illustrate what I mean by that familiar quotation from Shakespeare:

> Who steals my purse, steals trash; 'tis something, nothing;
> 'Twas mine, 'tis his, and has been slave to thousands:
> But he that filches from me my good name,
> Robs me of that which not enriches him,
> And makes me poor indeed.

Malaria has robbed the tropical and subtropical countries of their opportunities throughout the ages, and in addition to this robbery, it has filched from them their good name. It has blackened their reputation among the people of the Temperate Zones. And this, to my mind, is the most serious of all losses from malaria. The white farmer of the North or Northwest will not come to the Southern States, buy a small farm and raise his children there, because of the fear of malaria. Who could blame him in the past? But have we not reached the point where we can assure him protection against malaria in many sections of the Southern States?

Mr. Le Prince. Doctor Bowers.

Doctor Bowers. Mr. Chairman and gentlemen, it seems to me that the paper we have just heard is one of the most valuable contributions to the subject that it has ever been my fortune to hear. If that paper were translated, simplified, put in popular language, and made available for millions and millions in this country, I think it would accomplish more actual good for the conservation of human health and happiness than any similar thing, except perhaps the work in which I am now interested, the care of teeth.

You have proved that you can mitigate the incidence of the disease. You have succeeded in ameliorating that condition in certain communities by the use of the top minnows, by quinine, and various other methods, drainage, ditching, dynamiting, and so forth; and these activities return themselves to the community in increased efficiency and in decreased mortality.

There was something that Doctor Fricks has just brought out, the stealing of the purse of life and health, of initiative, of energy, and of everything that goes to enable a person to give his best for the land in which he lives. He can't do that very well if he has wasted a lot of energy chasing mosquitoes. Now, I have a summer place down at Wading River. We are not troubled by the Anopheles, we have no malaria, but we have plenty of mosquitoes, and the only way we can get any relief from them is to use the copper screens. We have our windows and porch and everything else screened up. Sometimes you have to sit behind these screens as behind a barricade, especially when there is no wind or when there is a land breeze.

But if this matter from the broad constructive standpoint on which this malaria control is based could be presented to the people of the United States so they could see it as clearly as we do, it seems to me, in all common sense and decency, they couldn't do otherwise than be interested; and Doctor Carter and this conference have placed in their hands the means to remove the greatest menace to human life and efficiency and develop the greatest curative power that has ever been known on the face of the earth.

Mr. LE PRINCE. The subject is still open for discussion.

Doctor CARTER. I ought not to say a thing, because I have been quoted enough in the paper. But in my opinion it is certainly erroneous to say that $2.50 would cover the damage that malaria does to the average man in the district described. The thing is this: This land is just as good as the land in Illinois, every bit as good as the land north of Cairo. It was settled at the same time. The land in Illinois is selling for from $175 to $300 an acre. I don't know what the land is selling for down in southeastern Missouri. I know that across from Cairo, in Missouri, when I lived in Cairo, land was selling for $15. The difference is mainly due to malaria.

I will say this—that no place where malaria seriously prevails is habitable by white people. I don't mean they can't live there; but they can not thrive. People can live and work in the Amazon Valley, but white people don't try. There can be no thriving white community where malaria seriously prevails. The first part of America settled by English people was in the Virginia peninsula. It is good land and it is most convenient to markets, yet there are practically no white farmers living there. There are negroes, and they just live from hand to mouth. There are some white people, but they are gathered together in little places where they try to keep themselves well. You can't overestimate the damage that malaria does to white people. It is the only disease that is incompatible with white civilization. In any place where malaria seriously and permanently prevails, there is no white civilization. It doesn't exist. Typhoid fever, pellagra, tuberculosis, are negligible compared to the damage that malaria does.

Mr. LE PRINCE. Mr. Fuchs, will you please close the discussion?

Mr. FUCHS. There are many men here who have figures showing in one way or another losses from malaria in the towns they have been working. If you can not give them now, I will urge you to turn them in as part of the discussion, so that we can get all of them together.

Mr. LE PRINCE. The next paper will be "Malaria control campaign at Greenwood, Miss.," by Mr. Clarke.

MALARIA-CONTROL CAMPAIGN AT GREENWOOD, MISS.

J. L. Clarke,
Sanitary Engineer, International Health Board.

In discussing the problem of malaria control in Greenwood, I want to state at the outset that the problems encountered were not unlike those to be found elsewhere. The people demanded that there should be a noticeable absence of mosquitoes; this they would judge for themselves, and further, they demanded that malaria should be reduced and put the burden of proof upon the director. The established principles of control which have proven successful elsewhere were applied in their relative importance here: Drainage to pave the way for general improvements and to reduce the maintenance cost of oil operations; oiling and fish control of permanent waters, and oiling and larvicide treatment of wet-weather pools, storm drains, catch basins, and fire-protection barrels; and the removal of artificial water containers from home premises.

The purpose of this paper is not to discuss field methods, but rather the methods of financing and prorating the costs incident to the demonstration. Therefore, I want to analyze the situation at Greenwood merely as a means to an end, namely, to submit a concrete example in order to make clear just what portion of the costs should be borne by the city, what portion by the cooperative agencies, and what portion by the individual property owners, and how these funds may be raised.

It is an easy matter to be generous with the funds which have been provided by our directors in order to get a contract signed, but it is a hard proposition to get the work financed by local town boards without some such inducement. It is possible, however, and should be done if the work is to gain headway. Each year the work must cover a greater territory and the funds available grow less in proportion to the area which must be covered. Therefore it is not altogether a problem of field work, but of the proper procedure of prorating cost in order to avert a reaction which necessarily follows the spending of easy money. Just here I want to compare cost features of malaria control with those of general health work of a county health unit. The work of a county health unit should embrace malaria, and in order to suggest a working basis it would be well to look into the costs which go to make up each. In establishing a county health unit it is customary to have the county appropriate $5,000 to meet an equal sum to be provided by the cooperating agencies. This $10,000 is used in the most part for salaries for directors and assistants, who point out defects in health conditions, leaving it to the individuals to correct these conditions at their own expense, only charity patients being recipients of a small portion of the money spent. Then the cost of the county health unit work goes almost entirely for educational work. Malaria-control work is different. The difference lies in the fact that the greater part of the initial cost is spent for drainage and not for the inspection and supervision of disease prevention. If we are to put malaria control on the same basis as other health work, then the cooperating agencies should bear only one-half the cost of promotional work, supervision of construction, inspection and oiling—educational work. This is the point I wish to bring out, that there must be a separation of items of cost for malaria-control work, otherwise the work will meet with the disfavor of those who are called upon to give Government and State funds, or else will be limited in its scope to a few intensive projects.

The towns and individuals must pay for drainage work. The Government and State should aid in the supervision of construction, maintenance, and oiling.

Before taking up the method of separating drainage cost, I want to describe in a general way the city of Greenwood and the conditions having to do with mosquito breeding, so that you may have in mind just what I mean by separating drainage costs from inspection and oiling.

Greenwood is situated in the Mississippi-Yazoo Delta, on the Yazoo River. It has a population of approximately 8,000. It is the headquarters of a number of large wholesale concerns, is a cotton market of importance, and has a number of manufacturing concerns. It has the commission form of government and well-organized civic organizations. It is a conservative, progressive city. The built-up area covers about 2 square miles. The malaria-control area embraces about 5 square miles. Within this area of control is considerable water surface to contend with, consisting of both natural and man-made mosquito-breeding places. A field inspection in the fall of 1920 showed that there was little possibility of breeding in the larger bodies of water—the Yazoo River and Pelucia Bayou. Both of these bodies of water have clean banks at the summer stage and are well stocked with small fish. Jennings Bayou, on the outskirts of town, was thought to have enough minnows to control breeding, but an inspection in the early spring of 1921 showed it to be producing Anopheles in great numbers in the presence of minnows.

The stream is about 10 to 30 feet wide and the water surface covered with brush and bushes and floatage. On the southern outskirts of a negro section there is a cypress brake of some 400 acres, which is flooded each year and contains water a greater part of the season. This brake was placed under suspicion, although very few mosquitoes were found in the fall of 1920. Inspection this season showed an early crop of mosquitoes about blackberry time, mostly of the woods variety. At the same time a scattering of Anopheles was found. No flight from the brake could be detected when breeding was at its greatest. The woodcutters and blackberry pickers said that mosquitoes were worse some years than others, and that the season of 1920 had been an "off year." In 1921 very little breeding took place in the pools left by the receding waters in the brake, as these pools were well stocked with minnows until they dried up. During the remainder of the season there was not enough rainfall to cause wet-weather pools. However, had a rainy season occurred in midsummer, perhaps this would have accounted for what the local negroes termed "an exception to the off season."

Except for the brake and Jennings Bayou, the large bodies of natural water are not mosquito breeders.

Contrary to my experience elsewhere, very little trouble was experienced with breeding in wet-weather pools, as the Delta soil takes up the water quickly after the early ground water recedes, and rainfalls of short duration disappear within five or six days.

Man-made breeding places constituted the main source of both Anopheline and Culicine breeding. Named in order of their sanitary importance as Anopheles breeders, the railroad borrow pits held first place; street gutter ditches next. Street gutter ditches might have been placed in the same class with the wet-weather pools had they not been fed by leaking hydrants and artesian wells, and in most cases it was a problem of stopping leaks rather than providing outlets for small shallow ditches.

While the existence of out-of-door breeding places caused great economic loss, against which we are fighting, yet by no means did they produce the larger number of mosquitoes. There is no doubt whatever that the Culex production scattered throughout the city in storm-drainage sewers, catch basins, basements, and fire-protection barrels have been in the past the cause of mosquito annoyance. The inspection and oiling of the Culex-breeding places was the greater part of the cost of control work, although the fire-protection barrels, about 1,800 in all, maintained by 16 manufacturing concerns, were oiled at their own expense. Likewise, basements and necessary artificial water containers were oiled by the property owners. Even with this expense eliminated the oiling of Culex-breeding places on city property was the greater part of oiling and maintenance cost.

In the foregoing I have stated the conditions and relative needs of control work. These same conditions are met with in other places and are handled in the same manner in which they are here, but in some cases the money of the cooperative agencies goes for city outlet ditches and street improvements. This should not be the case and can be avoided by separating the drainage cost from the cost of oiling and inspection. The main item of cost at Greenwood was the Walker's Lake Canal, which was 3½ miles long and was constructed about 10 years ago. It served its purpose well by draining farm lands adjacent to it to a degree, but was never deep enough to take care of two 36-inch storm drains which were designed to care for the storm water falling upon about one-third of the area of the city of Greenwood. The outlets of these sewers were submerged and the water backed into the mains, laterals, and catch basins, and, needless to say, bred mosquitoes in profusion during the entire summer season.

To get an outlet for these sewers and to provide an outlet for the 400 acres of cypress brake the deepening of the ditch was deemed necessary to the program. Unless this were done the campaign would be a failure; yet, on the other hand, the cost of the work was prohibitive for the town alone; and certainly the money of the cooperative agencies should not pay for the digging of a ditch to benefit farm lands and city property. So, in order to prorate the cost among those who would receive the benefits—agricultural benefits were involved—the landowners along the canal were called into conference and a small drainage district formed. The agreement provided for the payment of the initial cost of labor and material by the landowners in the event that the city would agree to assume the responsibility of its construction, advance the funds, and maintain the work thereafter. This agreement among the property owners was submitted to the city as a part of the contract between the city and the cooperating agencies. The cost of this outlet ditch was estimated to be $5,000. Cost of the control measures within flight range of the city was estimated at $3,600.

From the figures given it may be seen that on the face of the contract the cooperating agencies gave only $1,200 of the $8,600 provided for control work. This was brought about by the separation of the cost of drainage from inspection and oiling and their offering to share one-third of the less costly items of the program, namely, maintenance, inspection, and oiling.

Construction work was started about the 1st of May, was abandoned on account of high water, and was resumed, together with oiling operations, the 1st of June. The working force consisted of a foreman of construction and 12 men, and an inspector and 2 oilers. These forces were made a part of the street department and reported to the street foremen, who handled the pay rolls and directed the work under my supervision. I might have handled it separately, but I wanted to make mosquito-control work a part of the city's regular business of street cleaning and street improvements. I wanted to graft it, so to speak, onto a permanent structure already functioning, that it might remain there.

In carrying out the work, several interesting situations arose. At the beginning of the season Culex mosquitoes infested all of the storm drains and catch basins, but no breeding was found in tin cans until later, about the latter part of August. There was one sewer in particular from which they swarmed, making it almost suffocating to crawl in a manhole when the discovery was made. The sewer was an old abandoned structure, badly constructed, and had become silted at the manholes, holding water in the barrel between these points. It was impossible to cover the entire stretches between manholes with oil. The sewer was cleaned by flushing and oiled at the manholes and drip cans installed, but in spite of this breeding set up again. The sewer was fumigated with sulphur to kill the adult mosquitoes which had already taken wings, but was not very successful, effort to fumigate led to another and better method, which I want to call particular attention to. In carrying out this latter plan, all manhole covers for a distance of three blocks were removed and 5 gallons of gasoline poured slowly into the upper manhole and allowed to drift to the lower end. At the lower manhole a lighted torch was lowered, and when the gasoline reached this point it ignited and flared the entire length of the sewer barrel. This method was used in the beginning of the season to clear the sewers which had already become infested, in order to gain control until oil or other measures should be instituted. Drip cans placed at the heads of sewer lines having a continuous flow were successful, but in the old sewer, having no flow, a by-pass had to be constructed from another storm drain which carried hot water. This introduction of hot water into the old sewer line gave permanent relief. The Culex disappeared within a period of two weeks. It may be interesting to note that the water at the lower end of the sewer was not hot enough to prevent breeding, but the draft in the sewer brought down a humidity from the upper end which prevented breeding through the entire length.

The Walkers Lake Canal, which was blasted by T. N. T. and dynamite, has been discussed. The only other point worth mentioning is the help rendered by the Boy Scouts. The Boy Scouts were called into service late in the season when breeding started in tin cans. The early spring clean-up had taken care of the situation in the beginning, but the summer accumulation of cans contributed to local breeding. There were a number of reports of mosquito annoyance during the latter part of August, and investigation showed that the source of breeding was tin cans. The work of the Boy Scouts aroused public sentiment against artificial containers and was very helpful in controlling this phase of the situation.

The campaign was explained at the beginning of the season in a talk before the Kiwanis Club and before the Woman's Club, and one or two news items were run in the daily paper each month. These news items served to keep the public informed, to bring in reports of mosquito annoyance, reached small communities in the field covered by it, and in some instances went even further, being copied by papers having a state-wide circulation.

The main outlet ditch was the principal item of drainage cost and was paid for by the property owners. It cost $3,849. Drainage maintenance cost was $198. This sum covers only emergency work done by the inspector's squad, as it was the policy of the inspector to oil street gutter ditches until the city street force should provide outlet ditches, or the city waterworks force could stop leaks. The cooperation of these departments was responsible for making drainage maintenance cost almost negligible. The city street force constructed about 2 miles of ditches and the Yazoo & Mississippi Valley Railway spent about $3,000 in draining their borrow pits. The railroad work was also handled by their own forces.

The items of inspection and oiling are the principal costs, which were shared by the cooperating agencies and amounted to $660.32. This cost included 620 gallons of oil and 55 gallons of creosote.

MALARIA-HISTORY CENSUS.

A malaria-history census was begun August 15 and completed October 3. The actual number of days of field work were 28, averaging reports from 51 houses each day. All houses in the city were visited once, but no return calls were made in case the occupant was absent. Therefore reports were had from only two-thirds of the entire population.

The standard history-census card was used, and data were obtained from January, 1920, to the date of taking, particular attention being given to the current season.

From January, 1921, to September 15, the middle of the census-taking period, there occurred 342 cases of malaria. Assuming that this incidence holds true for the entire population, we would have 505 cases for the said period; and as this period embraces only nine and one-half months, in order to convert the data to a full-year basis it is necessary to further increase this figure by applying an incidence rate by months to the months covered by the census. In Mississippi we have this data covering a period of seven years. This would give 740 cases for the entire population for the year 1921, a morbidity rate of 9.5 per cent.

The number of cases reported for the year 1920 was only 88. This is evidently incorrect, and brings up a point which I would like to have discussed. Last year, history-census returns from the three towns which I worked gave less than half the number of cases for the preceding year, and in the case of Greenwood twenty-two times more during the year in which the work was done than in the previous year.

I attach no importance to a history census taken which covers a back period of more than six months and very little importance to any history census. All exaggerate conditions.

In comparison I want to give the returns from the local practicing physicians, which cover a period of four months—June, July, August, and September. There are 18 doctors practicing at Greenwood, and, with the exception of one, the returns are complete. The total number of cases reported are 158.

Making a correction similar to that applied to the history census returns to bring the data to an annual basis, there would have been 276—a morbidity rate of 3.54 per cent as compared with that of 9.5 per cent shown by the history census. Accurate information could not be obtained whereby it might be determined just what proportion of these cases were relapses and what proportion new infections.

One interesting feature which the history census brought out is that the malaria morbidity rate incident to the population in the white residential section where the houses were poorly screened was a very little less than that incident to the negro section, where the houses were poorly screened. In the white residential section, where 88 per cent of the houses were screened, the malaria rate was 7.7 per cent, while in the section populated by the working class, mostly negroes, the malaria rate was 11.3 per cent, only 3.6 per cent higher. It is a conceded fact that screens reduce the chance of infection 30 per cent in badly infected areas. This would indicate that there were few malaria mosquitoes present to carry infection.

Taking the doctor's reports as being more nearly correct, and assuming the economic loss incident to a case of malaria at $30, the entire economic loss at Greenwood for the year 1921 was $8,280.

Analyzing further the doctor's reports, we find that 80 per cent of their entire malaria practice was in the rural district and 20 per cent in Greenwood. This was arrived at by tabulating the malaria reported to the county health officer covering the same period for which their reports were made for the city of Greenwood.

In conclusion, I would call your attention to the necessity of separating the cost of new ditching from that of maintenance drainage, inspection, and oiling. To offer State aid for maintenance drainage, inspection, and oiling should be the policy of the cooperating agencies.

Where new ditch work involves agricultural benefits to individual property owners, as well as mosquito control to the city, the promoting of a definite proposition to submit to the council will go a long way toward saving funds to be provided by the cooperating agencies.

The feasibility of eliminating history census taking from the program and substituting therefor doctor's reports to show the malaria incidence for the demonstration area should be considered.

As to field methods, there is an opportunity in some cases to reduce the cost of inspection and oiling permanently by introducing hot water or manufacturing wastes into storm sewers. To reduce the number of mosquitoes which have already taken wing, as a temporary expedient, the gasoline flare may be substituted for fumigation in sewers.

Mr. Le Prince. The next speaker will be Mr. Stromquist.

Mr. Stromquist. Mr. Le Prince has asked me to say something about mosquito-control work at Memphis, which I shall do, not with an idea of showing that as a model but as an illustration of control work in a large city.

We have not limited ourselves to Anopheles control, but must attempt to control the production of Aedes and Culex as well. Our organization for the work is, of course, governed by local conditions.

We employ three inspectors. One of these was a regular sanitary officer, who was paid out of the mosquito fund from April 1 to August 1. Most of that time he was detailed to the garbage division of the engineering department, and his work consisted in going over various sections of the city and getting back yards cleaned up. When tin cans and other rubbish had been piled up he would be followed by two garbage carts. Of course, this eliminated a large number of breeding places. At times he would inspect fire barrels at industrial plants and assist in investigating complaints. Another sanitary officer was employed on the mosquito work from May 1 to October 15, mainly on house-to-house inspection, inspection of fire barrels at lumber yards and other plants, and investigation of complaints. The third inspector was a college student, employed during his vacation and employed mainly on inspection of bayous.

We did very little ditching or cleaning; in fact, practically all that was done was on days following rains, when the oiling was suspended and we wanted work to hold the gang together. This policy was due to the fact that we were advised by the engineering department and the city attorney not to work on private property. We have about 35 miles of bayous in the city, some of which have been covered.

Any improvements to be made must be made mainly by building culverts, which on private property must be done by the owners either individually or by drainage districts, and in the streets by the city. The engineering department is now cooperating by building culverts with rounded bottoms and proper slope, so that the culverts which will be built in the future will not provide breeding places as do some which have been built in the past.

On the oiling work we had a truck driver and four or five white laborers with a 1-ton Ford truck. We did not employ a foreman, but the truck driver was familiar with the city and would distribute the men. The oilers worked in pairs, one man oiling the main stream, the other its branches. All the bayous were oiled on an average of three times per month.

The oil used was a mixture of black oil, waste oil from garages and filling stations, used transformer oil, and kerosene. By collecting waste oil and buying discolored kerosene we were able to get our oil at an average cost of about 7 cents per gallon, including the cost of hauling and mixing, as compared with 17½ cents per gallon in 1920. The fire marshal assisted us by telling us where waste oil was available and by notifying garages and other places that they must not increase their fire hazard by allowing waste oil to accumulate about their premises. Our average cost of oiling was about $4.35 per mile, including wages of truck driver and laborers, oil, supplies, such as rubber boots, etc., and maintenance of the truck. The truck driver was paid $90 per month, the oilers $2.50 per day. We averaged 6.8 man-hours of labor per mile.

We investigated every complaint of mosquitoes that came to the office and a number which were solicited by making inquiry as to prevalence of mosquitoes. From the early part of July to the 1st of October we had about 300 complaints and in 30 per cent of these we found breeding places on the premises where the complaint came from. The most common class of breeding places were: (1) Cans, tubs, etc.; (2) pools from leaky plumbing, ice boxes, drains, etc.; (3) barrels; (4) cisterns.

Records were kept of the oiling and ditching work and of the inspections. One form was used for the oiling gang on which one side provided space for reporting the places oiled. After we got complete records of the places to be oiled the list was made out in the office, and all branches of a bayou and other places which required oiling would be listed together and checked off as they were oiled. In this way we did not have to depend on the memory of the oilers in covering all the places. On the reverse side of this report was provided space for recording the number of men and hours' work, amount of oil used, and also memorandum of supplies received or other information.

For reporting inspections two forms were used, one for stream and the other for house-to-house inspection. The first provided space for reporting the section of stream inspected, number of dips made, and number of dips where Anopheles and Culex were found and the size of larvæ. The other form showed the address of the premises inspected, type of breeding place found, and action taken. Monthly summary was made of the oiling, ditching, and inspections, and a monthly progress map was kept which showed, in addition to the work done, the location of the mosquito complaints.

The matter of record and reports may be carried too far and more attention paid to them than to getting the work done, but we have found in our health department that records are extremely valuable at times. Several times during the summer persons come to the office to complain that some bayou had not been oiled all summer, but by having a record we could prove to them that the work had been done.

Appropriation for the mosquito-control work was $8,000, of which about $5,450 was spent. Including engineering supervision, the total cost is about 4 cents per capita and 40 cents per acre, of which about 18 per cent is supervision, 24 per cent inspection, 47 per cent oiling, 4 per cent ditching, and the balance the cost of oil-storage tank and surplus oil, which will be available at the beginning of the 1922 season.

The malaria rate has had an increase in 1921 over 1920 similar to that through the Mississippi Delta. We do not get complete reports on cases, but about 33 per cent of our deaths from malaria are nonresidents brought into Memphis hospitals. The malaria death rate from 1911 to 1916 was 67 per 100,000; from 1917 to 1921, 25 per 100,000. Control work was begun in July, 1917.

Mr. Le Prince. The next paper will be by Mr. Parker.

CONTROL OF MALARIA IN TEXAS BY REDUCTION OF ANOPHELES QUADRIMACULATUS ONLY.

GEORGE PARKER.

Sanitary Engineer, International Health Board.

As a means of controlling the transmission of malaria fever in a defined area by the elimination or successful control of *Anopheles quadrimaculatus*, the following results obtained in the town of Dialville, Tex., during the malaria season of the present year are offered.

Dialville is a town of approximately 220 inhabitants, and the boundaries, embracing the built-up section, average about one-half mile in each direction, although 1 square mile of territory embraced the control area. The attached sketch indicates the general topographical conditions, the western half of the town being hilly, while the eastern half is generally flat. The territory on the sketch inclosed by the square represents the built-up section of the town; most of the houses are clustered near the central point, and it will be noted that in this section the prolific *A. quadrimaculatus* breeding areas are located.

The town people subscribed a fund of $75 to combat malaria fever. The Cotton Belt Railway, the road that serves the town, rendered assistance by supplying the necessary amount of oil and a pump to spray the oil.

During the time when the breeding of *A. quadrimaculatus* could be expected to be heavy, it was not uncommon to be able to dip up as many as a half dozen larvæ with an ordinary drinking dipper in almost any section of the breeding areas. By inspection *A. punctipennis* were found to be breeding along the stream areas. Only a few *A. crucians* were found during the season.

In May active operations were started to control the breeding of *A. quadrimaculatus*. The program decided upon consisted of the employment of one laborer at a rate of $3 per day for one day each week. Oiling was resorted to until the breeding was under control, and then, by digging a few feet of ditch each week, in addition to keeping up the oiling, the worst areas were relieved of water. No work was attempted to control any mosquito breeding except as noted. Fire barrels and domestic breeding containers were kept under control both as a precaution and to eliminate the Culex nuisance.

Total expenditure, oiling (labor and material)	$74.24
Ditching, new work, 0.25 mile	15.00
Clearing old ditches, 0.05 mile	3.00
Railway transportation of labor	7.70
Total	99.94
Distribution of funds:	
Town	75.00
Cotton Belt Railway	24.94
Total	99.94
Per capita cost	.45

The results obtained from this work are evidenced by the following data of malaria fever cases which occurred in the town area.

Total cases reported by the two practicing physicians, January to October, inclusive, 15. A house-to-house canvass, totaling 55 houses visited and 216 persons accounted for, developed that in 1920 there were 37 cases of malaria fever, and in 1921 only 16, a reduction of 57 per cent. It will be noted that the cases reported by the doctors and those recorded by the survey show a difference of only 1 case.

Of 55 students examined in the local school, representing 41 rural families, 24 gave malaria histories for the past two years, divided as follows: 1920, 12; 1921, 12. This indicates that the malarial infection remained practically constant during the two years used for comparison, and would further serve to indicate that *A. quadrimaculatus* play a very important rôle in the transmission of malaria fever.

Summing up the data, we find that by directing activities against the *A. quadrimaculatus*, the malaria fever rate in this village shows a reduction of 57 per cent for a per capita cost of $0.45.

Mr. LE PRINCE. To-morrow morning we shall have the session open for general discussion.

You will remember that at our last conference we discussed the value of the burning of vegetation, and it was suggested that we go deeper into the matter and find out the cause of the failure. Mr. Ropes will speak to us on the subject. We want to learn how to eliminate grass in ditches.

Mr. ROPES. We had very heavy rains in Arkansas last year and the grass grew approximately 2 inches per week, I should think, in the ditches. When I took up the work in Dermott we had 6 or 8 inches of grass in the ditches; there was prolific breeding, and the grade of the ditches was already below the grade of the culverts through which they were expected to drain. Of course, the only thing I could do was to oil and do the best I could under the circumstances. Consequently I was very much interested in Mr. Shaw's paper on the Hauck burner. All his work was absolutely successful in destroying vegetation. He did get rid of the brush; he did get rid of the weeds and everything else, but the cost was excessive. Now, I looked over his paper carefully after getting it, and I found that one reason his cost was excessive was that his crew was too large. It seemed to me the solution was to develop some type of apparatus that could be handled by a smaller crew.

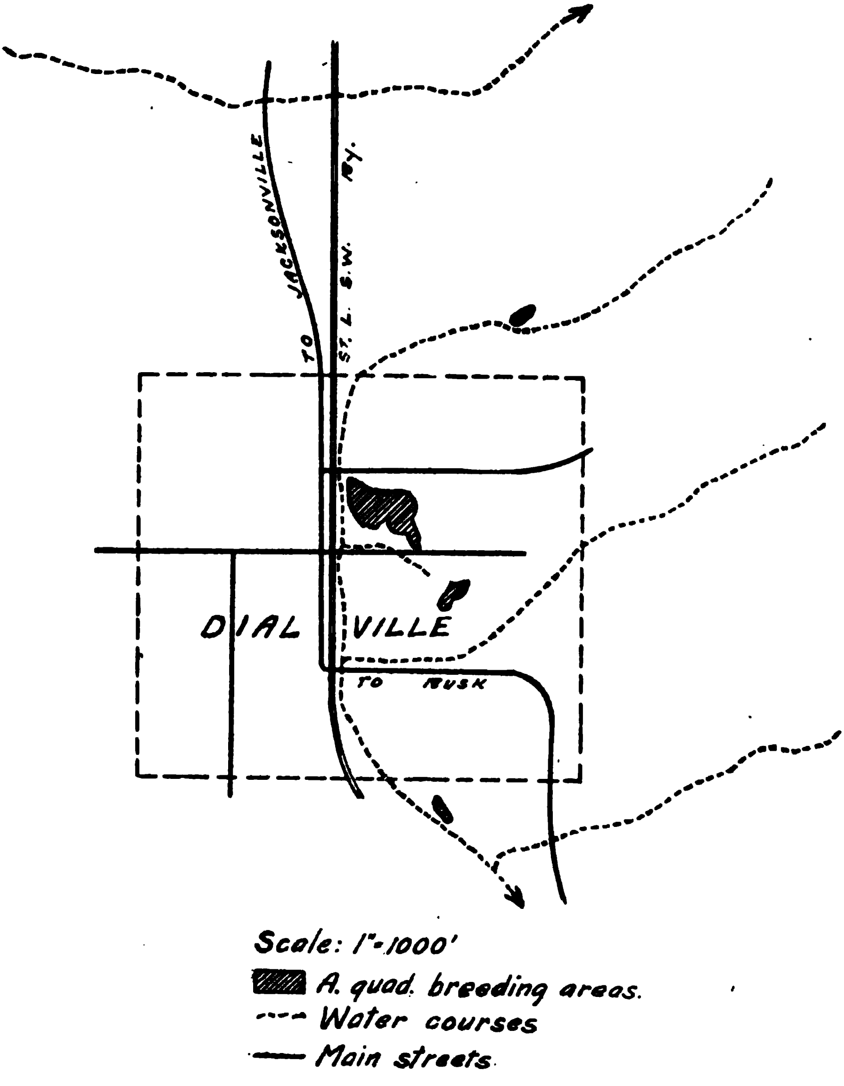


FIG. 8.—Skeptch map of Dialville, Tex.

When I was in Brooklyn last spring I went over to the Hauck factory and met their sales engineer and his assistant and we had a long conversation there. We went over the whole factory; they showed me all their types of burners, and we finally devised an apparatus with a 15-gallon tank such as you will see in the exhibition hall, with 25 feet of hose, which they guarantee is oil-proof, at the end of which is a burner. This apparatus is mounted on 18-inch wheels. I proposed to use that in Dermott, but I had to go to Alabama and never got to it.

In August I got a letter from the assistant sales manager of the Hauck company. It appeared that he had sufficient interest in this grass burner to assemble the apparatus, took it out to his place in New Jersey, the general location of which I am familiar with, and tried it out. He reports that he burned a strip 8 feet wide and 100 feet long, containing ordinary weeds 3 or 4 feet high, scrub oak and maple, in 20 minutes with one man. Now, if that is true I know it is cheaper than anything I have succeeded in doing yet. I got clearing like that in Anniston at approximately $80 an acre, with labor $1.75 a day.

I have the same question this year in Orrville. We have a ditch that is anywhere from a foot to 18 inches below the edge of the culvert. Well, we cleaned that ditch out. That ditch had been cleaned successively for several seasons, and the grass, dirt, and everything had been thrown out. Now, there is no use going any further because the ditch is already too low. I understand from Mr. Johnson that they have ordered one of the burners to be tried in Mobile. I am sure that all of you will be very much interested to find out how it works and what the cost will be, and I really think that we have solved the question of getting rid of grass and weeds in ditches of this character. I might add that for an extra cost of $4 you can get a spray attachment and use the apparatus for spraying oil. The cost of the whole assembled tank on wheels, with hose, is $215.

Mr. Le Prince. Does anybody wish to ask Mr. Ropes any questions?

Mr. Shaw. It is a fact that in Baton Rouge last year the Hauck burner was tested when labor was high and with two men to operate it. We worked under disadvantages. The burner came late in the season and we were without sufficient funds to experiment with that apparatus. The container was placed on the ditch bank and carried from place to place. It had to be advanced as the burning was done.

I certainly have to be shown in the matter of burning weeds 3 or 4 feet high, on the basis that Mr. Ropes speaks of, because we had cocklebur bushes about 4 feet high and the corresponding stalk that you will find in a weed that high, or about an inch in diameter, and I think it took something close to five minutes to burn a stalk sufficiently to cause the bush to fall of its own weight. I reported last year the work was unsatisfactory and said I was surprised by the quickness with which the vegetation returned in Baton Rouge. There was not very much difference in the time as compared to the regrowth after cutting.

Mr. Le Prince. I am under the impression that Mr. Ropes, after conversation with these manufacturers, has evolved a new type of burner or some new features of the machine. Anything I have said was not intended to be a reflection upon the efforts of those who had tried the old type burner.

Mr. Ropes. I am familiar in a general way with the vegetation in that part of New Jersey. This gentleman lives out in Elizabeth, and I doubt whether anything but the scrub oak and maple present a serious proposition. The stalks of the weeds are very seldom over a quarter of an inch in diameter and they grow 3 or 4 feet tall. There isn't anything like what you have to contend with down here.

Mr. Le Prince. Is there any further discussion on the subject?

Mr. Komp. I used a Hauck burner on nothing but "Bermuda" grass, green, and on that my cost ran something like $14 an acre. I have no record of how permanent that work was, but Mr. Davis can tell us something about that.

One place where the Hauck burner, or any other burner or torch, or anything of the sort, can be used successfully is in the control of the big Psorophora larvæ that occur in temporary rain-water pools. Within 12 hours after the rain falls the wiggle-tails hatch, for the eggs are laid in the dry mud in the bottom of the pool, between rains. If the bottoms of these pools are burned out, the eggs will be destroyed and the next brood prevented from appearing.

Doctor Bowers. While this is a little apart from the subject under discussion, I thought perhaps it may not be inopportune to make a suggestion which occurs to me. You exhibited this morning a very interesting moving picture showing the development of the mosquito and its life history.

Now, on the matter of publicity work, I would suggest to you, Mr. Speaker, if this picture is to achieve its greatest success, that the man who is responsible for the writing of the captions on this picture simplify those captions in order to get a popular understanding of the matter. When he says that a "mosquito retains its perpendicular position," it would be much better, to my mind, to say it "stands up straight," and so on along that line. Get your message down to a 14-year intelligence if you want to make it valuable.

Open Session, November 17, 1921.

Mr. Le Prince. The meeting will come to order.

When suggestions were asked for, one or two suggestions were received that it would be better to have an open session rather than have fixed papers. Some said fixed papers were the best. I am going to ask Mr. Komp to take the chair.

Mr. KOMP. As I have to discuss a paper at another section meeting this morning, the best thing we can do will be to elect a permanent chairman for this section. Do I hear any nominations?

(Mr. Ropes was nominated.)

Mr. KOMP. The nomination has been made, and the secretary is instructed to cast a unanimous ballot in favor of Mr. William Ropes as permanent chairman for to-day. Mr. Ropes.

Mr. ROPES. The meeting will come to order. The meeting is for general discussion; if anybody has anything to say, why now is the time when he is expected to give everybody the benefit of his experiences. It doesn't make any difference how small the fact may be he has to present. The meeting is now open.

Doctor FRICKS. I wish to say a very few words, Mr. Chairman. We have had a splendid conference. We hope to have another next year in Chattanooga.

This is a conference of field workers in malaria—here to discuss the problems which they have encountered during the past year and their methods of handling them; also, the problems they have met which they want assistance in solving. We must not lose sight of the objects and purposes of these meetings. If we do, they will no longer serve a useful purpose and the Surgeon General will then have no justification for authorizing our attendance.

Next year we are going to be compelled to adjust our conference meeting more closely with the section on public health and the meetings of the national malaria committee. This will be discussed with Mr. Le Prince at headquarters.

I am delighted to say that it is the engineers who have done the biggest piece of work that we have accomplished this year. In my opinion, Mr. Johnson's work in Alabama is most original. It is along the lines that we must expand if we are to demonstrate that malaria can be controlled over large areas at reasonable cost.

I want to say just one more word about the necessity for coordinated effort among us in malaria investigations and demonstrations. The time has gone by when one man could go out and handle his job separately and distinctly from the work of others. Mr. Le Prince and I represent the bureau at malaria field headquarters, outline the season's work, the policies to be pursued, and assign to each man his part to the best of his ability. We expect each man in the field to assume full responsibility for the detail duties imposed upon him, and that whenever he is in grave doubt as to proper procedure or policy to be pursued, he will report the same to us and call on us for assistance. It is only by working together, each man doing his full duty, but remembering that the malaria problem is of enormous extent and that there are others working in the same field, that the greatest results can be accomplished with the least loss of effort and the least friction.

Mr. KOMP. I should like, if possible, to have Mr. Le Prince discuss the work that Mr. Johnson has done in Alabama, giving the reasons why Mr. Johnson was able to do that particular piece of work, and also to suggest means whereby the State health officers in other States can lay the foundation for county-wide work. I think if he will do that it will be one of the most valuable contributions we can have.

Mr. ROPES. I think it is a good idea. Mr. Le Prince.

Mr. LE PRINCE. Regarding the work initiated by Mr. Johnson in the counties, the important thing was to realize that there were agencies there that could be utilized. There were health workers there who were going to stay there. He was careful first to think over the matter carefully and decide which was the best way to approach these all-time county health authorities so as to make them as interested in malaria work as he was himself. That was the first big point. The second point was, he made them realize that by taking up the mosquito work they could do their other sanitation work very much more satisfactorily as the public became interested. Mr. Johnson had the good fortune to work in a State where the State health officer is decidedly interested in malaria control and where he has been very successful also in selecting good health officers, a very important point in sanitation.

Mr. Johnson has so planned his time that he can return to the units he has started before the men who are doing antimalaria work have had the opportunity to get far ahead with it. He had a lot of problems on hand, but he keeps his finger on the pulse of the situation all the time. He doesn't let things go too far before he sees how they are going on. You can't expect in work of that sort to obtain a hundred per cent result immediately. An 80 per cent result is good, particularly if the county health officer who is directing the work is sufficiently interested. He will know that this is only the start, and later on he will increase that 80 per cent.

Doctor Welsh explains to the men before they start on a problem what the difficulties are going to be, and has arranged so that the State board of health will give funds only to the county health departments that provided the county health officer with an all-time inspector.

We may consider that the inspector is occupying a position as important as we are. We are relying on the inspector every time. We must keep on encouraging that inspector in order to increase his interest in the work. If we don't we shall fail and the work will fail, too. Everything comes back to that inspector. Now, supposing a field inspector who is getting a small salary realizes fully that the welfare of the people in his section of the State depends directly on him, that he has a most important position, it would be unfair not to increase his knowledge of mosquito control. I have been in places where the field inspectors didn't know Anopheles from any other mosquitoes. We must try to get a little more knowledge to our field inspection force. That is what leads to success.

Also, there is a chart here that relates right to this matter that I want to take up. It has a direct bearing on future work. I am thinking now of Mr. Johnson's work 24 months from the present time. I am not holding this up as a hundred per cent model—just as a suggestion to you. The most important thing to do is to teach the field inspector or the foreman, to keep a check on their work. Before the campaign starts locate a dozen or five dozen Anopheles resting places, places where adult Anopheles are numerous, and let your foreman know that the ultimate object of his work is to keep those places free from adult Anopheles. Let him take a big pride in telling you when you get around that he hasn't found a single Anopheles in any of those places. But, more than that, once a week get him to visit these places. Tell him, "That is the history of the Anopheles work in that town." The State health officer should have those figures given him right along. If anybody tells the State health officer that Anopheles work is wrong, he can just refer to the reports that have been sent to him and show the exact status of Anopheles prevalence. If your foreman can meet you at the train with a smile on his face and invite you to go around to every one of the culverts and other resting places of the Anopheles, and tell you that you can't find a *quadrimaculatus* or *punctipennis* in those places, you have won; you are not needed there. But suppose your field man is mistaken, and tells you they are not there when they are there, don't reprimand him but show him he is mistaken, and he won't be mistaken a second time if he is worth anything.

Doctor Griffiths. Mr. Chairman. I would like to take up a feature that is of practical value in the field, a question of a trap tube that I have used for several years in collecting live mosquitoes for dissecting, egg laying, etc. [Exhibits collecting tube.]

Mr. Ropes. Is that tube tight? Can you keep your chloroform in it for any length of time?

Doctor Griffitts. Oh, it isn't for chloroform; it is for catching live mosquitoes. You can catch mosquitoes rapidly in this and transfer them to a bottle or other container and generally get egg laying overnight. In this way it is easy to have an exhibit with you of live mosquitoes and Anopheles eggs.

Mr. Ropes. I think Mr. Komp had something to say on the question of Alabama work.

Mr. Komp. I simply wanted to get this on the record, and then when Mr. Johnson comes back we can discuss it.

First, what has made Mr. Johnson's work possible is the fact that he has in Alabama a State law which provdes for full-time county health officers. I think that Doctor Welsh is the only State health officer who has the advantage of such a law. Doctor Fricks, when he first gave us our instructions, said we were not to attempt antimalaria work in any county which did not have a full-time county health officer. The way that works out is something like this: The State of Mississippi is malarious in certain sections only. At the time I worked there, there were only seven full-time county health officers in the entire State. Of these seven, only two were in the malarious section. That about settles the question of where we can do county-wide work.

The second point is that Mr. Johnson is not held responsible for the success of the control work; he merely acts in an advisory capacity, and the all-time county health officer is responsible for the success of the work to the State board of health. Mr. Johnson is merely a traveling instructor for these county health officers. He shows them how, and they are held absolutely responsible for the success of the work. That is the way, according to Mr. Le Prince, that we all have to work in the future, because we can't spread ourselves out any thinner than we are now.

We must evolve methods to get adequate State legislation so that county health units will be permanent organizations, under the direction of qualified men, provided with sufficient trained helpers. Then they may be held responsible to the State board of health for the success of malaria-control operations in their counties, so that the sanitary engineer will merely make the survey and plan the work, leaving its execution to the county health officer. The county health units must be composed of a full-time county health officer with a competent inspector. In the State of Alabama each health unit has a full-time clerk, a full-time inspector, or a full-time nurse.

The nurse is usually supplied by another agency, but we must have a sanitary inspector in each unit which undertakes to do malaria-control work.

Mr. Kroeze. Do they carry on the same program that we carry on in Mississippi? You know in Mississippi the program will last at the most about three years, except in Bolivar County and Lee County, and I don't see how the county health officer can spread himself out any more. I know the fellows that I visit are so busy they can't do it.

Mr. Komp. I think I can explain that in this way: These county health officers, in a great many cases, are not only full-time county health officers, but are also directors of Rockefeller Foundation rural sanitation units, and that work is only supposed to be carried on until all the towns and the rural sections of the county are supplied with sanitary privies, which usually takes two or three years. Then the whole work of upkeep is turned over to the full-time health officer. That is true in Bolivar County; that is true in Lee County, Miss.

Another thing about our difficulties: I had malaria-control work started in the county seat of one progressive county, with the expectation that it would be extended to the county under the supervision of the county health officer, and the county health unit blew up. That is the difficulty of health work in the Southern States; it isn't on a sufficiently permanent basis, legislative or otherwise, so as to make it possible at the present time for more of the States to do malaria work, and until we get the necessary legislative basis and more permanent health units, we must get along on the old plan.

Mr. Foster. Mr. Chairman, there occurs to me, the matter of houses which can not be screened. I am thinking that perhaps not many of us will be working in places where we will have the benefit of a compulsory screening ordinance. I am afraid that we are too much inclined to admit that there are houses, habitations, where it is impossible to screen. We picture the typical laborer's house. We think it can't be screened. There are crevices and there are cracks that admit mosquitoes. It is difficult to screen those things. There are a great many places around turpentine camps and sawmills where we may find materials that lend themselves to stopping crevices. Rough carpentry, very rough, can be utilized, provided we avail ourselves of material such as hay, shavings, pine straw, and even sawdust, and Spanish moss that hangs from the trees in a great many parts of the country where we have so much malaria. Such stuffs can be gotten and crammed into the crevices, and only very rough carpentry is necessary to make it stay there. We must not admit, we must not allow the people to believe that they have buildings that can not be made mosquito proof. There are ways to do such work and the cost need not be insupportably expensive.

Doctor Carter. I want to ask the engineers here one question. I have been asked by Mr. Mendelsohn about malaria articles. Now, none of the malaria articles have much to do with the engineering part of the control work. They are medical articles, professional articles, biological articles.

I do not know whether it is worth while or not. There are some articles, for instance, by some Holland people, that are of interest to a physician or an entomologist, or a mosquito man, but they haven't any engineering features in them.

Mr. Stromquist. I think the more general knowledge we have of the medical end of it the better we can do our work.

Mr. Shaw. Mr. Frank and Mr. Le Prince suggested that I show this chart and ask everyone to think about the situation and give a reason for this condition on the Mississippi coast. I have separated the protected area from the unprotected area, and find the reduction in the former to be greater than in the latter.

It is natural to question this unusual drop in the unprotected zone. Doctor Williams's explanation is that it is due to education in prevention and cure, but even though there has been a great deal of work along this line, such results do not seem possible. I doubt it. But another point, the northern part of this county is high- and well drained, and possibly now, with the mile strip of the coast being free of Anopheles, the people from this section who came down to the infected area didn't get an infection and carry it back as they did formerly. Doctor Williams says they go down to the coast and spend a day and then go back, and I think that is true. There is one road through the middle of the county, and most of the people come by wagons or autos and go back without spending much time on the coast.

However, has anyone an idea to suggest as a cause of this reduction? I believe these reports are dependable; they are checked very closely.

Mr. Komp. I am familiar with that work, but I have no explanation to offer. The difference in population ought to be taken into consideration. The total population of Harrison County is about 35,000, and I think that about 25,000 live on the seacoast, in three or four towns, the largest of which is about 10,000 and the smallest about 2,000.

There may be something in the fact that the species of Anopheles is different in the two sections. Upcountry I think the prevailing species is *punctipennis;* on the seacoast the prevailing species is *crucians. Crucians* is thought to be almost as good a carrier of infection as *quadrimaculatus.*

Mr. Shaw. This chart might be of interest. The upper line shows the gradual increase of expenditures on the initial work throughout 1918, amounting to practically $102,000, followed by the maintenance costs throughout 1919 and 1920, or $10,000 a year. At any point on this line we can read the total cost to that time. Now, by plotting deducting ordinates from the line of expenditure equal to the economic saving up to that time, we provide points through which the line of financial balance (lower line) passes. This line of financial balance crossed the zero line just prior to the end of 1920. At the end of 1920 the capital investment had been replaced and there was a net revenue of $1,781.13. In other words, by the end of 1920, during three years, there had been spent a total of $121,718.87 and the work had effected an economic saving of $123,500. This economic saving is based on an allowance of $40 per case per season, and the computations are made on the number of treated cases reported. On the basis of the 1921 conditions, there having been 112 cases treated (the full report being at hand as I revise the notes) instead of the before-control average of 1,539.5, the economic saving in this and all subsequent seasons will be $57,100 or a net revenue of $47,100, the maintenance cost being $10,000.

If the commissioners fail to appropriate the $10,000 any year, they will deprive the 32,855 people of this dividend of $47,100, or it would be the same as taking from each man, woman, and child the amount of $1.43.

Mr. MAGOON. Mr. Chairman, I have just two questions I would like to ask. How soon after a female Anopheles emerges from the water may that female Anopheles be prepared to lay eggs—the minimum time?

Another question is: Is there not some kind of a woods Culex mosquito that takes the same position as the Anopheles with their tail in the air?

Mr. ROPES. Will you answer those questions, Mr. Mayne, please?

Mr. MAYNE. In respect to No. 1, the minimum period in which a female Anopheles is prepared to lay eggs is six days. That is under the most favorable conditions regardless of whether they have been fertilized or not.

Mr. KOMP. There is a species of Anopheles which assumes the posture of a Culicine, but it doesn't occur in the United States. If you see them sitting up with their tails in the air, you may be practically sure they are Anophelines.

Mr. MAGOON. I was referring to a small mosquito about the size of the ordinary Culex, a little bit larger than the *Aedes calopus*, that has spotted legs. Its body and wings resemble the body and wings of an ordinary Culex. People have assured me that their resting position was identical with the Anopheles resting position.

Doctor CARTER. There is an Anopheles that takes the position of the Culex, but the contrary doesn't occur. There is also a Culex with spotted wings, but it doesn't occur in this country; in California, I believe.

Mr. MAGOON. Mr. Chairman, may I ask another question? I would like to ask if anybody can keep the true Culex adult alive more than a day in a bottle or a jar?

Doctor COOGLE. If it is the *Psorophora ciliatus* that you refer to, I have a specimen on exhibit; you can keep these fellows alive for a week without feeding them. By feeding them a little sweetened water they will live several weeks, provided, of course, the temperature ranges somewhere between 60° and 90° F.

Mr. SMITH. I should like to ask what mosquito it is that looks like a Stegomyia and is not a Stegomyia?

Mr. HILDEBRAND. I think that I know the species to which Mr. Smith refers. I took some specimens to Washington, where they were identified by Doctor Dyar as *Aedes sollicitans.* They were breeding in a ditch at Savannah, Ga., which was polluted with the acid waste from guano works. This species had previously been recorded only from brackish water, so upon the suggestion of Dr. L. O. Howard I wrote a notice to Science, reporting the catch.

Mr. PARKER. May I ask Mr. Hildebrand a question?

In a village where I conducted work this year, there was a cellar beneath one of the business houses which, for various reasons, contained water throughout the year and was a source of prolific mosquito breeding. The area was about 1,900 square feet. In the spring about 500 Gambusia were placed in the water and for several months excellent mosquito control was experienced, and also a noted increase of the fish. Suddenly all the fish died and mosquito breeding reappeared. More fish were introduced and they disappeared within a few days. No enemy to the fish could be discovered.

At the rear of the building there was an opening leading into the cellar, through which a great deal of trash and rubbish was thrown from time to time, and I think perhaps through this channel the water became acid polluted. I wish to ask what might have caused the fish to die after surviving so long in the spring and early summer?

Mr. HILDEBRAND. I can not answer Mr. Parker's question, but there is a possibility that something containing acid was thrown into the cellar. We must remember in using fish control that a mere trace of acid will kill fish.

Mr. SHAW. I want to ask the members of the conference if anybody has observed the phenomenon of cannibalism among the Anopheles larvæ.

Mr. MAGOON. Mr. Chairman, I have observed large Anopheles larvæ would destroy ones perhaps half their size among the Anopheles.

Doctor CARTER. I have seen them eat dead larvæ; I never saw them eat a live one.

At Quantico, on the Potomac, the camp had about 200 pigs. We placed them between the camp and Chappawampsic Creek—a prolific source of Anopheles. I advised them that many Anopheles would stop with the pigs and that I did not believe this slight increase of blood supply—we had over 5,000 men—would increase mosquito breeding.

Cows and pigs have a great attraction for Anopheles—the majority of Anopheles stop at their stables. They stop in the stables and you don't find them around the men's quarters.

I have recently read the statement of a Danish entomologist. It is said in Denmark they have bred *Anopheles maculopennis* that won't bite man at all; they feed entirely on cattle. Doctor Barber has made a number of experiments along the same line. He slept in one pen and the pigs in another and they found more Anopheles in the pigs' pen than they did in his. You have to consider two things, however: (1) That the Anopheles biting animals are not biting men and (2) the possible increase of mosquito breeding by the extra blood supply.

Mr. PARKER. I would like to ask Doctor Carter a question: Some months ago there appeared in a western paper a full-page illustrated article announcing the discovery of a certain bacteria which destroyed mosquito larvæ. The discovery was made by examining Anopheles larvæ found dead in pools, the cause of their death being attributed to this bacteria. However, experiments with the larvæ of Culex did not prove successful, and an effort was being made to find a bacteria that would destroy that species.

If such bacteria are available, the inoculation of mosquito-producing pools would greatly simplify the field worker's problems.

Perhaps Doctor Carter knows of this discovery.

DOCTOR CARTER. No.

Mr. JOHNSON. That article first appeared in the newspaper and shortly after it appeared our chief engineer gave it to Doctor Welsh, and somebody lost it. Along about that time I was telling Doctor Barber about it, and he said he would like to get hold of that article, but the article was lost.

Mr. HILDEBRAND. I have a copy and shall be glad to send it to anybody who wants it.

DOCTOR COOGLE. May I ask Doctor Carter a few questions? Is it considered absolutely necessary that a female Anopheles mosquito have a blood meal before her eggs are fertile? In southwest Georgia, tiny red bugs were noticed on larvæ, pupæ, and imagoes; as many as 25 or 30 have been observed on one adult mosquito. Is this common in other places? Has any work been done to try to propagate these bugs or to determine their usefulness in destroying mosquitoes or mosquito larvæ?

DOCTOR CARTER. I believe blood is necessary for Anopheles to lay eggs, not necessarily to make them breed, but make them so they will hatch.

I don't think I know enough about the red bugs.

Mr. JOHNSON. I made an observation in Alabama last year which was somewhat along this line in one of the lakes that Mr. Kibbey was controlling. We had a little beetle—I don't know what it is—about as big as that thumb nail. It had a sharp spike. All of a sudden it jumped and grabbed the Anopheles and stuck him up on the spike. We had him in a glass of water with about fifteen wigglers, and in about a half an hour he just took them with the legs and stuck them up on the spike one by one. I would like to know if any work has been done on that beetle.

Mr. Komp. He is known as *Belostoma americana*, the electric-light bug, and he will not only kill mosquito larvæ, but he will also kill small fish.

Mr. Magoon. I would like to ask if the little beetle that you saw was swimming on his back. There is a back swimmer that will grab pupæ or wigglers and devour them one after another. This little back swimmer is the most energetic beetle that I know of for taking wigglers.

Mr. Ropes. On the matter of these beetles, I think Mr. Mayne knows something about them. Mr. Mayne, have you made any observations on these parasite beetles?

Mr. Mayne. Doctor Coogle referred to some red bugs on the mosquitoes' bodies and legs. I don't think it derives any nourishment from the mosquito, but I think you had in mind the red mite. If it is the mite it doesn't derive any nourishment at this stage; it is simply there for the purpose of getting a free ride, for transportation. There is a certain stage which it is necessary for it to go through in order to complete its transformation, the so-called tyroglyphid stage. This may be what he has in mind. I don't think it does the mosquito any particular damage, unless in such great numbers as to immobilize it, weigh it down, as often happens.

Mr. Johnson. Mr. Chairman, there are two points I would like to bring out about the insect I referred to. The fact that they ate the wigglers like they did—that one in the glass of water. The second is that when we caught that bug there happened to be some children around there. It was in one of Mr. Kibbey's camps, and I think we had about 300 children looking around to find more wigglers and more beetles. When it catches that wiggler and puts him on that spike I know that it certainly catches the interest of the youngsters in the community.

Mr. Komp. Some work has been done in New Jersey on these red mites. So far as is known they are of little importance as destroyers of mosquitoes.

The beetle that Mr. Johnson speaks of is not a beetle, but one of the water bugs, probably of the genus Corixa. Many of the aquatic beetles in the adult stage are not as voracious as their larvæ, which are very destructive. Other predaceous insects which prey upon mosquito larvæ are the back-swimmers, or Notonectidæ, the water striders, water scorpions, and dragon-fly larvæ. They should all be protected and encouraged in their work, but the chief difficulty in their use on a practical scale is that it is impossible to increase their numbers artificially to such an extent that they will be of value as a means of control.

Mr. **Hildebrand**. I wish to get back to the subject of killing wiggle tails by the introduction of bacteria. In a certain area near Augusta, Ga., we frequently find a very large wiggle tail which I think may be a species of Aedes, containing a brownish growth on the body that sometimes increased the normal diameter of the wiggle tail twice or even three times. I do not know that the growth kills the wiggle tails in nature, but those taken to the laboratory did not hatch out. Now, of course I do not know whether this growth was caused by a fungus or by bacteria.

Mr. **Parker**. I understand that the disease which is produced from this bacteria is hereditary; that is, if the female survives her attack, the eggs, or larvæ, that hatch from the eggs contract the disease and die before they mature.

Mr. **Hildebrand**. Mr. Chairman, referring again to the bacterial growth, or whatever caused the growth, I wish to say that whenever the wiggle tail had only a small amount of it, it went through, but when the whole wiggle tail was practically covered it did not reach the imago stage in the laboratory jars.

Mr. **Komp**. On my wiggle tails the only thing you could see was the breathing tube. They looked as if they had fur coats on, with the breathing tube projecting from the fur. However, they pupated normally, giving adults of *Psorophora sayi*.

Mr. **Old**. We have considered putting in iron culverts.

Mr. **Ropes**. Mr. Clarke, have you had any experience with some of those culverts?

Mr. **Clarke**. I know that they work well, and the cost of installation compares very favorably with any other form of construction; but as to the life of them I couldn't say.

Mr. **Ropes**. Has anybody else had any experience with these corrugated-iron culverts?

There are two different things—corrugated iron and corrugated steel. There have been a very great many unfortunate experiences in Alabama with these corrugated metal culverts, but there is a wide difference between the materials that are used for the purpose. We shall be glad to hear from anyone who has had experience with the iron culvert. And we would like to hear from anyone who has had any experience with them in acid water or salt water.

Is there anything which anyone would like to have discussed by the engineers? Anybody who has had any experience on matters that have not been brought up?

Mr. CLARKE. Mr. Chairman, I don't see Mr. Carter here, but he mentioned just a while ago that we ought to discuss the publication of these notes taken this year—the proceedings. I don't know what idea he had in mind.

Mr. FUCHS. Mr. Chairman, Mr. Carter suggested that very thing to me just a moment ago. I would like to ask of the men here who presented papers at this conference, how many could have mimeographed copies of their papers made and sent to all the other men.

Mr. FOSTER. I am pretty sure I can.

Mr. FUCHS. I think that would be the best way of getting the papers around to the men so that the benefit of the subjects discussed in the papers will be had by the men before the ensuing year is over. It seems that a certain amount of time must elapse before the Government publication can come out of the press, and I am confident that we can save time by getting mimeograph copies made. I am going to take that matter up more in detail later.

EXHIBITS.

Mr. ROPES. Is there anyone here who would state the outstanding feature of the exhibit they have seen here; what appeals to them most, what seems to them to be the most important?

Mr. E. B. JOHNSON. Mr. Chairman, I have one point which I would like to bring out in regard to the exhibits. I think we are all interested in that exhibit. When we go to this exhibit we find a lot of miscellaneous material. More is coming in all the time. Every person that came brought in a little and nobody knew what was coming or how much was coming, and the result is we got into a great mess over there. I think that is the fault of the engineers in the field as much as anyone else. The State health officers were told what they should bring and the engineers were told what they should bring. I have an idea which I think could be followed next year which, I think, would avoid any future confusion; that is, that a circular letter be sent out from the Memphis office, and in that letter every State, through its health officer or through its engineers, be instructed to send a letter to the Memphis office, to arrive not less than one week before the conference, stating what he will bring, and that only this material will be put in any exhibit. If we do that I think it will be a great way of getting a good exhibit in the right place at the right time.

Mr. VAN HOVENBERG. I would like to add a word about the value of exhibits. It seems to me that we are very sadly in need of a moving picture that isn't entirely technical, something that might be produced and sold as a popular film is sold. Perhaps a film that would picture the distress in a manufacturing town due to the presence of Anopheles in that community, with a little romance or love story to go with it that would please the public fancy. There is a possibility in that line.

Doctor BOWERS. As to the matter of writing a love story around Captain Mayne's film, I don't think it is necessary at all; there is sufficient scientific or instructive value in the film standing on its own merits to warrant its being presented in that form as very many films now are presented. I think that you would simply cut the thing up in weaving a love episode around it. I think the film as it stands, with the addition of a little bit more human interest, perhaps a little more humor as well as interest, would be absolutely eligible. When I get back to New York, I will see Mr. Hill about it.

Mr. STROMQUIST. I had a little experience with exhibits two years ago shortly after I came to Memphis. I was directed to prepare an exhibit for the Tri-State Fair in Memphis, with the idea of using that as the basis for a more permanent exhibit later, and we had no funds available. I think we used maybe, 30 days for the purpose of having a man make up the charts for us, or posters, and we made up a number of large posters and several smaller ones. There was a series of those posters in just as few words as possible, giving the story of malaria, and the smaller posters were generally pictures of work from different places, and we got from Mr. Van Hovenberg some of the models that he uses in his exhibit car on the Cotton Belt Railway, and then we had a little aquarium with Gambusia and larvæ in it. We filled up considerable wall space with these posters, and I don't believe so much in posters and charts at a fair. There are very few people who stop and read them, particularly if you have several hundred square feet of wall space covered with them. They get discouraged before they have started reading them. A thing like an aquarium with top minnows in it will attract more attention than posters. Of course, there are a few people who are very much interested in this and want to learn something about it, and you need to have some one with the exhibit to explain to them, and possibly it may really do more good in the case of a week's fair if you talk to a dozen people who are really interested in what is on these posters, and give them the information, than if several thousand people stop and look at the Gambusia; but something like the Gambusia and larvæ will attract more attention than the posters.

There was one exception to that. We had one poster so attractive that some one went away with it. It showed the results of the work at Crossett, Ark., in dollars and cents; that is, the average cost per capita, and the doctors' bills for the various years, and the cost of malaria-control work. I think we had four years shown on that, in two panels, with transparent celluloid over them, and in that we put the actual cash of the per capita cost the first year. We had on this side the cost of the doctors' bills; on the other side, the cost of the malaria-control work. The first year was something like $2.50 for the doctors' bill, with nothing in the other. The second year was, I think, about 70 cents for the doctors' bill and about $1.20 for malaria-control work, and when it finally got down to the last year we had a record of, we had two little dimes in the doctors' bills and a half a dollar on the other side. There was a rather impressive chart. I left it at the exhibit building, and the next morning I came out there and all that was left of the poster was the little eyelets that we had to put the tacks through. It was rather discouraging, but Mr. Le Prince and I went into our bank accounts and bought some more material and made another one, and this time I made these panels of extra heavy paper and with clips, so every night when I left the fair I took it home with me. I left the poster there, but took the cash with me. That exhibit was shipped around all over. Some time ago the young lady who is doing the malaria-control work at Helena, Ark., came up and wanted some exhibit material and I found this poster for her.

Doctor CARTER. What appeals to me the most in the exhibit here is Mr. Hildebrand's fish and larvæ. One of the men that came in knew nothing of malaria control. I think he was fascinated by the way the Gambusia picked up the Culex and Anopheles larvæ. I think the "live stock" are the most interesting.

Mr. STROMQUIST. I do believe that any exhibit should have something that would interest the general public, such as live stock, and then also have some form of statistics and charts for the person that is more interested, in order that he can get some definite information from them.

I remember one of the posters we had in that exhibit with pictures on it. I went through the files and took some of the photographs that had been used and found a number of pictures of houses in delta towns, so we made up a poster, and we said: "Mr. Planter, how can you expect good crops and efficient labor"—I don't remember the exact words, something like that—"when your tenants live in houses like these?" We had those few words in the center of the poster and then the pictures all around them. I had a friend who has a plantation right across the river from Memphis, and he looked at that, and said: "You are slapping me right in the face with that thing." I don't know whether he has improved his tenant houses or not.

Mr. MAGOON. Mr. Chairman, the Texas State Board of Health has been using exhibits at different conventions and public gatherings, and there is one thing that seemed to me to attract more attention than anything else in the exhibit. That is the steromotorgraph.

It is a small machine that projects a slide. They had, I think, 200 slides that are projected one after the other without any operator looking after the machine. It is possible to have under this slide a certain amount of writing matter explaining what the slide is, and hundreds of people will stand each hour before that machine and watch it go through a run.

We have some malaria-control slides showing pools and explaining something about them, and some things of interest of that kind, and I believe that one of those steromotorgraphs, loaded with 200 carefully chosen slides, would attract more attention even than the fish.

Mr. E. B. Johnson. Mr. Chairman, we ran several exhibitions at county fairs in Alabama this year. There were three things which seemed to attract more attention than anything else.

In the first place we used Doctor Carter's live-stock idea and had good exhibits and demonstrations of Gambusia.

In the second place we used a big jar of wigglers and a jar of kerosene (marked). We would pour some wigglers into a big test tube and, without saying a word, pour in some kerosene on top. With a thick film the wigglers die quickly, and it made a most effective demonstration.

In the third place one of us would say, "I'm going to find some mosquitoes," and would start for a stable or bridge with two or three test tubes. The boys would follow, and in a short time every boy in the neighborhood would be hunting mosquitoes. It was very effective.

Mr. Fuchs. In seeing some of the exhibits it occurred to me that for the use of a permanent exhibit it might be feasible for each State or each man to make tracings of the charts so that any number of blue prints or white prints can be made. In that case when the charts are lost they can be very easily replaced and duplicated.

Mr. Shaw. An idea was suggested to me regarding a mosquito exhibit which might be equally applicable to general exhibits.

My stenographer had prepared five charts showing the four stages of mosquito life, and the fifth showed the distinguishing marks, and it was my intention to post them in their proper order, one each day, and place thereunder samples of the respective stage of life. In discussing the matter with a reporter he suggested that the egg poster was very unattractive in its nature and thought it would be better to display the winged insect first, to catch the eye of those passing. I objected to the reversal of their proper order, whereupon he suggested some introductory poster such as "Jiggs" being bitten by an Anopheles, a drawing of which he had seen on the blackboard in the office. The suggestion was followed and the poster entitled "Jiggs Contracts Malaria," "Learn About Mosquito

Life," "Watch This Exhibit." The day the poster was placed the paper carried an article explaining how "Jiggs" contracted malaria and what he would have to do to cure himself of it.

The entire exhibit was followed closely and much comment made. The posters were large and done by hand, and the artistic work attracted immediate attention. If this idea can be introduced into the general exhibits it is possible that they will attract more attention. I think the live exhibits are very attractive and many of our visitors were first attracted by the aquarium of Gambusia. The layman will not study charts. I doubt very much that anyone other than those particularly interested in malaria control studied the posters and charts and digested the statistical data thereon. I think we should work toward a general picture for such exhibits and away from diagrams. The block diagram is very pretty and illustrative (to us), but I doubt if it carries its lesson to the layman.

Mr. STROMQUIST. You mean by the block idea the wooden blocks?

Mr. SHAW. No; I mean the diagrams on cardboard. For instance, how many laymen stopped to study every one of the charts shown at the Mississippi exhibit or any number of them? There was too much of it, and for that reason they passed it all by. They wouldn't take the time to go over it; they passed it all by and went over to look at the instruments and the machinery and the fish.

Mr. CLARKE. I think we ought to give the public coming to those exhibits a comprehensive idea of the whole situation; that is, in the form of a chart to show the relative economic loss due to all of the diseases in these Southern States and let them know from what diseases the greatest loss occurs, and what cause next, and down the line to the very least of the preventable diseases. On one side of this chart we would show, say, covering a period of five years, the number of cases and deaths for each disease; on the opposite side of it show the economic losses due to the respective diseases. Possibly malaria and tuberculosis would lead this chart and then the others would come down in proportion to their losses which they give. This would fix the relative importance of each disease in their minds, and then they could assimilate the details as they went through the display.

Mr. PARKER. I want to make a suggestion, which I think might add to the ideas for exhibits.

Charts, etc., demonstrating in a technical or scientific way results that have been obtained are of little value in reaching the person who is not acquainted with them, and it is likely that some may get the reverse idea from what is actually shown.

To demonstrate how antimalaria work is done, perhaps it would serve to advantage to have an exhibit for use at county fairs and similar places, consisting of an ordinary pick and shovel, a large tin fish, a can of oil, an oil spray pump, something to represent a stick of dynamite, a bottle of quinine, a plow, etc. Such an exhibit could be labeled in large print, "What to use to control malaria." Certainly it would attract attention.

Doctor CARTER. In any exhibit, it seems to me there should be two aims. One is to impress a man who does not know anything—the utterly indifferent man; the other is to give information to the man who is interested and who does know something.

Mr. E. B. JOHNSON. Doctor Bowman, the health officer of Montgomery County, has just devised a new way of educating school children in malaria. His scheme, in brief, is a set of charts about 4 feet by 2, put up on the wall. The first chart is merely a picture of a mosquito; the second shows a man all huddled up over a fire having a chill, with his wife feeding him hot soup and a mosquito biting his bald head. The third one is a picture of a well man swaggering down the street; the fourth shows the same well man at home, with the mosquito shown in chart 2 biting him on the bald head; chart 5 shows our well man having a chill. Chart 6 shows some breeding places. The last charts tell briefly what to do to prevent malaria. The charts were drawn by a professional cartoonist and are so amusing that they attract interest at once.

Now, these were designed for schools, but I think they would be very good to use in an exhibit.

Mr. KOMP. In that connection I think we should be careful, when we are educating the man that Doctor Carter spoke of, that knows a little bit about malaria, when we are drawing our pictures and making our models, to be as nearly scientifically accurate as we possibly can. Some of the models and drawings at the exhibit depart a good way from scientific accuracy. I am merely bringing this up because I feel that we, being the national agency for the control of malaria, ought to be as correct as possible.

LARVICIDES.

Mr. ROPES. We have had a discussion by Doctor Barber on the use of arsenic. I would like to know if any of us have had any experience with anything else. You will recall that Mr. Johnson, discussing Doctor Barber's paper, mentioned the use of cresol dip in killing larvæ in a water-cress pad. I have had some experience with cresol dip myself and I would be very glad to hear from anyone who has had any experience with any larvicide other than those mentioned.

Mr. SHAW. At Columbus, Ga., there were 1,500 catch basins, and Mr. Le Prince has said that Columbus was the greatest of all towns for catch-basin breeding. It presented quite a problem. We first oiled them, but such was expensive, so we tried niter cake. We placed as high as 30 pounds of niter cake in a catch basin containing probably 20 gallons of water, and it was not effective. The only reason I could see for this failure was the very high clay content in those catch basins, which probably neutralized the niter cake.

Another experiment we made with the catch basins was the use of waste from water-gas production. This by-product contains considerable ammonia and was very effective in the laboratory, but two 10-quart buckets in a catch basin failed to affect the larvæ.

Mr. **Magoon.** Mr. Chairman, the use of niter cake in about 100 barrels proved effective.

I also had some experience in the use of ammonia waste, and have found that mosquitoes will breed in certain ammonia wastes. Ammonia waste, of course, is an alkaline waste, niter cake is an acid waste, and I think we have to determine which is necessary by experience, but I am inclined to think that at cotton plants, for instance, and in the different cotton-storage warehouses, niter cake placed in the barrel will take care of mosquito breeding.

Mr. **Shaw.** It has been my experience that niter cake breaks the hoops on barrels. Large industrial plants are likely to make it rather unpleasant when the barrels begin to break.

Mr. **Old.** We tried putting lime in barrels about the middle of September. We found no breeding since. I have been using half a pound of lime in a barrel and that will last three months. I send a man around about every 15 days to stir it up. It is claimed that the 50-gallon barrel will take in solution a half pound of lime. I believe for safety a pound will be better. Mr. Foster had some experience in that line.

Mr. **Ropes.** Mr. Foster, we would like to hear from you.

Mr. **Foster.** At Thomasville there were 57 water barrels treated with lime. The amount of lime used was 6 or 7 pounds, ordinary builders' lime. At Blakely, in one place—these are widely dispersed towns that I am talking about, from 50 to 70 miles apart—at a hardwood mill, there are 43 barrels treated with lime. About 10 pounds of lime were used for it. Some other barrels were treated with oil for a comparison. The barrels which contained lime had no breeding whatever in them, no eggs even, and showed no remnants of wings to cause belief that mosquitoes had been about them. The barrels which had been treated with oil had come to this condition: A froth was to be seen on the surface. This froth was a broken surface in numerous places. We all know that if oil of any sort is used for filming small containers and a number of treatments have occurred that we have left a froth, and unless we clean away that froth after awhile we can't get a good coating of oil on the water beneath the froth—so it was that we found some breeding in the barrels getting oil treatment. In the lime-treated barrels we never found any breeding at the hardwood mill at Blakely.

As for the lime experiment some 30 barrels had been treated with lime in a cotton warehouse at Blakely. Some of these barrels have been under observation for the past four months. There has been no breeding that I have seen, and I have inspected there frequently, and I have had other people to make a report on it. It seems that the use of the lime in fire-protection barrels acts as a deterrent of oviposition. I have been told that if one should take wiggle tails and introduce them into the barrels treated with lime they would go on to maturity, though they would not thrive well.

In another town there has been a finding the same as those before cited—no production in lime-treated barrels.

Now, as to the amount of lime that should be used, I don't know what that should be. Some have told me that 6 or 8 pounds should be used. It is desirable that enough be put into the barrel so that later on we may be able to find the lime in the bottom of the barrel when we stir it. With any such small quantity as 1 pound of lime one wouldn't be able to "feel" the lime in the bottom of the barrel.

While I am on the floor, I would like to ask a question or two. Whether some of us should not call up the proceedings of the last session and ask if any improvements have been made on a number of things that were advanced last year. I have been thinking that we have not yet covered the ground that was laid out for us last year as thoroughly as we might. I believe if they may be carried further it will be to the advantage of all of us.

Mr. Van Hovenberg. Mr. Chairman, I think Mr. Foster made a good point in one of his remarks to the effect that when new ideas are advanced, as several were during the last meeting, that they should be kept in mind and everybody asked to demonstrate their experience at the succeeding meeting.

Some one suggested last year that an inspector might carry a small bottle of creosote dip, with a syringe, so that when he came across a bad breeding place he wouldn't have to tell his oiler, but instead would immediately stop the production of mosquitoes. Has anybody here made such a contrivance?

I believe Mr. Foster's point is well made. It would be worth while to have some means devised to bring these matters to our attention next year.

Mr. Ropes. As I understand, it is the purpose of this discussion to bring out anything new, anything that comes to our minds, and to bring out anything that was not finished last year.

Such a case was this of larvicides, and Mr. Johnson at that time brought up the question of using these various cresol compounds. Now, perhaps some of us have had some experience with them the past season and so, as the subject is brought up again, it would certainly be valuable to everyone here.

Before we leave this question of larvicides, Mr. Johnson has had more experience with them than anyone else and I expected to call on him to tell us about his experience with cresol compounds. In his absence I will have to state as well as I can what success we have had with them in Alabama. I suppose we have used them more than anyone else; I think it is one of Mr. Johnson's hobbies. Furthermore, we have in Alabama many open sewers—places where people discharge the sewage from their houses without any treatment. In these places it seems that oil is ineffective; there seems to be a scum on the surface which protects the Culex from the action of the oil entirely, and we have found in those places that cresol compounds are extremely effective. They form an emulsion with the sewage and kill the larvæ very promptly. We have made no quantitative determinations in their use at all, excepting a few I made myself. I found that the use of creolin in a dilution of 1 to 1,000 would kill Anopheles in from two to five minutes. It was proportionately longer as the dilution was increased. So far as I know, these are the only experiments that have been made. I asked Doctor Barber if he had made any and he said he had not.

There is another thing to be determined in regard to cresol compounds, and that is: What does the business? It has been attributed to phenol. My personal opinion is that phenol has nothing to do with it.

I used cresol dip in Orrville—it cost about $1.50 a gallon in large quantities—and in another place I used another cresol compound that cost 90 cents a gallon. The cheaper compound was by far the more effective.

I hope that during the coming season more of you will use these cresol compounds because they are so effective against Culicine mosquitoes and that at the next meeting we will hear more about them—the details in regard to the quantities and the different kinds that are most effective.

I simply state these experiments for what they are worth. That has been our experience and we used these two to a considerable extent. I should be very glad to have in detail experiments with similar compounds and get the results, quantitative and otherwise, because our experiments have been almost too rough and ready. We have used, more or less, enough to kill the mosquito larvæ, and that is all. It is practically fatal to all animal life. I first used it in a pit which had been excavated for a cotton gin. The negro sent down to spray it made sure that he used enough. First, the larvæ were killed; then the water bugs came up; then the frogs and fish and finally a snake. The negro then thought it was enough. It seems to be fatal to almost any animal life, especially if used in large quantities.

Mr. KROEZE. In connection with my work in Mississippi, at one town they had a number of storm sewer outfalls that had gouged out holes and it was expensive to try to drain them and water stood in them all year long. We found that we had to oil quite frequently; it was so dry and they were exposed to the sun and there was no vegetation at all, so the inspector began using creosote dip with his oil and found he didn't have to oil as often as with oil alone, as he found that creosote dip lasted longer than the oil alone did.

Mr. VAN HOVENBERG. Mixed with the oil?

Mr. KROEZE. Yes; mixed with the oil.

Mr. VAN HOVENBERG. What percentage?

Mr. KROEZE. I think I used about a pint of creosote dip with the ordinary spray can.

Mr. ROPES. Five-gallon can?

Mr. KROEZE. I think it was a 5-gallon can. He wasn't very careful about how much he used. I think he used about a pint to one spray can full.

Mr. CLARKE. I noticed in those catch basins in Greenwood that were flushed each day the oil would flow off. I used creosote in them. The creosote lingered and was gradually diluted, but it was more effective than oil. I sprayed the sides of the catch basin as well, and it seemed to last about 15 days; that is, no mosquitoes went in there to lay. It didn't kill them, but it just kept them away. I would like to hear from some others on that.

Mr. ROPES. Has anyone else had any experience, particularly with cresol compounds?

Mr. SHAW. The only experience I had was with a compound put out by the Barrett people. I think they designated it as a larvicide. It is a by-product of some of their processes, but it has some elements that we are interested in. Its effect is similar to creosote dip. Although my experience in the use of it was not extensive enough to be absolutely conclusive, my observation was that it was entirely too expensive, especially when it was turned over to the average laborer. We tried it also in connection with the catch basins, but abandoned the use of it.

Mr. ROPES. Mr. Shaw, did you use that in any place where the water was heavily polluted?

Mr. SHAW. No; I didn't.

Mr. ROPES. My observation has been with cresol dip that it has a field entirely its own and we used it in places where the oil was absolutely ineffective.

I think this question of larvides is a thing we should bear in mind during the coming season and be sure to note the quantities that you use and the kind of product. There seems to be a wide difference, for instance, in niter cake. Some seems to have a higher acid content than others. Those things should be noted, because otherwise the information passed to somebody else might be misleading. The question of larvicides is very important, because I think we all have to use the thing we can get at most readily. This was the case at Faunsdale. They had about half a barrel of cresol disinfectant on hand; we could start work immediately and did not have to wait for oil to be shipped.

If we bear this in mind I think the experiences at the next meeting should be very interesting.

Is there any other subject anyone cares to discuss?

CULEX.

Mr. KROEZE. There is one subject that gave me considerable worry this last summer and that has not been brought up here. That is Culex breeding around sewage-treatment plants. It is one that I am interested in and I would like to hear from anybody who has had experience in this matter. This last year in particular it has given me a great deal of trouble, and there are at the present time three suits filed against one city, and one of the causes of complaint in each of the suits is for breeding mosquitoes. This treatment plant consists of an Imhoff tank, a dosing house, and two contact beds. When my attention was called to it, it was breeding more mosquitoes than I ever saw in my life. We succeeded in controlling the dosing house and the contact beds, but had little success with the Imhoff tank, due, I think, to some peculiarity of construction. I have found the same conditions in other towns and that you could find mosquitoes and wiggle tails around the tanks most any time. It is a pretty hard proposition to control and I would like to have some information on the control of Culex breeding around such plants.

Mr. ROPES. Has anyone had any experience in regard to the control of Culex in Imhoff tanks and septic tanks?

Mr. MAGOON. In two towns we have some sort of Imhoff tanks and sewage-treatment systems. In one of these towns we have mule barns and mule lots adjacent to that system, and there we have a great deal of mosquito breeding. We have tried oiling, but have not completely controlled mosquito breeding, but have reduced it noticeably.

A somewhat similar condition in another town was controlled by oiling continuously, keeping the oil from washing off into the outlet chambers by a baffle board and stirring up each day the oil that had already been put in there until control was secured.

Another tank incidental to the one near the mule lot seemed to have relatively little breeding. I know of nothing there that I believe safe to use other than to oil it and keep the oil on top, but in some places we found that we couldn't use the sprayer to advantage and have used the spray canvas, or rather drip canvas, with success. I think there are places where all of us may find it necessary to use drip cans to control oiling of sewage. I know I have found it essential to do that in 3 of the 11 places where I have been working.

Doctor COOGLE. It is a certainty that if you put crude oil or kerosene into a septic privy, it is going to stop the action of that privy. This has happened several times in my own experiences. Near Louisville, Ky., in the extracantonment area, 1,800 privies of the K. S. P. type were regularly inspected by an inspector under my supervision. Mosquito breeding was found in less than 25 of them. The inspector, a very intelligent man tried several oils and combinations of oils. Castor oil, or castor oil with a little linseed oil mixed, gave sericeable results.

Mr. ROPES. Has anybody else had any experience in regard to this quite important subject? It is very important, because of the Culex we have.

Mr. KROEZE. Mr. Chairman, regarding this question of the tanks, I spoke to the assistant sanitary engineer from Texas at the Louisville meeting last year about what they did in Texas regarding the Imhoff tank. I know they have a number of Imhoff tanks in Texas, and he said that they had one or two that they had screen covers for, and they worked very satisfactorily. I wrote several other engineers in the South for information and I couldn't get any information at all regarding taking care of Imhoff tanks. I have never seen an Imhoff tank with a screen cover, however, and I would like to hear something about that.

Mr. MAGOON. In Alabama, at one town, the Imhoff tank was screened, but it wasn't tightly closed; the screening of the Imhoff tank probably did no good, and it was not recommended by any engineer, so far as I know.

The city of Austin, Tex., has Imhoff tanks that are near where people live, and there have been a great many complaints of these tanks. There has been an effort made to cover them, and at the present time concrete covers have been made, or concrete roofing has been prepared, with provision made for burning the escaping gases. I do not think that the covering of the Imhoff tank would impair its usefulness, because the action that is supposed to take place in an Imhoff tank, the bacteriological action, is supposed to take place in the lower chamber, and the Imhoff tank, if working at its best efficiency, should have the upper only serve as a settling chamber. Perhaps Mr. Lenert has observed something in reference to the plant at Austin, Tex. I know the first time I saw it it was open, the same as any other system, but unforeseen difficulties came up and it was a nuisance, and in order to take care of the conditions that were occasioned at the time of that nuisance they put a wooden cover over it, and later a concrete cover was made.

Mr. ROPES. Mr. Lathrope, could you tell us something about the results that have been obtained in Arkansas this year in regard to various septic tanks?

Mr. LATHROPE. I have seen but one septic tank in the town of Malvern. This tank was giving a great deal of trouble to people in near-by houses on account of the odor rather than on account of mosquito nuisance. There was no mosquito campaign at Malvern this season, and no investigation was made regarding the prevalence of mosquitoes in this tank.

Our other towns where we have malaria-control campaigns have deposited their sewage in the streams. In one case, however, they have septic tanks, but there is no mosquito nuisance created.

Mr. ROPES. I have had some experience in septic tanks and Imhoff tanks. The first one was the one constructed by the United States Government near Camp Eustis. It was one of the most prolific Culex-breeding places I ever saw, and we dumped a whole barrel of oil in it. We got such a heavy scum we didn't have any breeding all that summer. It didn't seem to affect the effluent at all.

We had this trouble in a number of towns. The best thing undoubtedly is to house and screen the tank. Then there is no question of anaerobic action or anything of that kind coming up.

We screened an Imhoff tank that I remember at Searcy. It was no trouble at all, for that tank was properly screened and the door kept locked. That is important.

In Arkansas, I may say, they have established rather a unique way of getting rid of the trouble. In Russellville they have simply let the tank fill up. When I saw that tank last year it was solid right up to the top. There was simply a stream of sewage running right through from one side to the other. They had no breeding in the tank, but there was plenty of breeding in the effluent. We made a lot of experiments with the effluent, with about every grade of oil from the gasoline down to the heaviest oil, and we found it wasn't very valuable. We found the different creosote compounds very valuable in treating these effluents.

Has anyone else anything to say in regard to these septic-tank problems?

Mr. VAN HOVENBERG. I would like to bring up the question of the influx of mosquitoes during the late summer and the early fall. Probably everybody here has had the experience in the latter part of the summer of suddenly finding an influx of the small black mosquitoes, or some other variety, that have given a great deal of trouble.

Are we lax in letting our control lapse, or is there some condition that we don't know of?

Mr. MAGOON. Mr. Chairman, the situation spoken of by Mr. Van Hovenberg is one that I have had, and I have no other explanation for it than that barrels of cotton platforms and of cotton warehouses supply mosquitoes for this breeding.

Mr. FUCHS. My experiences agree with those of Mr. Magoon. That is, where my Culex control has been very careful during the season and has not lessened as the season advanced, but has been carefully kept up all season long, we have had no trouble with Culex in the towns that I have been looking after.

Mr. CLARKE. I want some information as to the life of the Culex mosquito, how long it remains around breeding places or infested areas, after breeding has been shut off. I have found in several instances that Culex disappeared almost entirely, or certainly there is a noticeable absence of them after about two weeks' time. I want to know if anyone here can verify that.

Mr. KOMP. Mr. Chairman, Mr. Le Prince has information on that subject, which he has kindly given me, which corresponds with Mr. Clarke's observations, that between two and three weeks is the period. That was also confirmed by my observations in Mississippi; if there is a large cesspool breeding heavily, with the chicken houses and outhouses near by full of mosquitoes and that cesspool is controlled, inside of three weeks the mosquitoes have disappeared from the shelters, and there is no more trouble from it. I think this is a very interesting point, and if anyone else has any information on it we ought to get it.

Mr. E. B. JOHNSON. We had a Culex invasion like that in the city of Talledega on about the 20th of September—there were absolutely no Anopheles mosquitoes. They appeared during the night and just drove the people crazy, and they investigated and tried to find the breeding places—had absolutely no idea where they were coming from—and in less than five days they disappeared just as quickly as they came.

Mr. KOMP. Mr. Johnson, do you know what species they were?

Mr. JOHNSON. No sir; I was not in the town when they came on.

Doctor GRIFFITTS. Mr. Chairman, at Newport News, Va., where work was started in 1917, the work has continued and the city has made a liberal appropriation each year for doing malaria work as well as general mosquito work.

This year they had very excellent Anopheline control. They did good Culex control up till August. Mr. Gage and I made an investigation in August, and we were asked by the city manager to make some statement in the newspaper (and, by the way, that is a good way to make statements, when it is requested by the mayor or the city manager). We made the statement that they had attained almost perfect Anopehline control. We warned against the Culex, some species that would come in September, and they are hard to kill with oil. We suggested that they make a house-to-house inspection and keep down the house-breeding Culex. It was fortunate that we warned them. There was an enormous influx of non-Anophelines in September. The people began to think that the work had fallen down. The invaders were Taeneorhincus. They stayed in the city four or five days and then disappeared. I felt certain they were blown or flew across the James River from Pig Point, 7 or 8 miles away. They are brackish-water breeders, as you know.

Mr. Ropes. We would like to hear some more about this Culex question. Most of us have not been so fortunate as to get rid of them in two or five days.

Mr. Le Prince. I want to refer to the *Aedes solicitans*, the salt-marsh mosquito. There was a case where immediately after the Anopheles work was done the Solicitans disappeared. The first year passed and the second year passed without them, and it was thought that maybe there was some connection between the Anopheles work and the Solicitans' absence, and somebody made the statement that it was the result of the antianopheles work. Then the Solicitans came back by thousands.

Mr. Ropes. Will anyone else give their experience on that—this year's Culex mosquitoes? I know everybody has been complaining about them, so I think everybody must have had some experience in regard to this question.

Mr. Magoon. Mr. Chairman, I would like to ask one question as to how high some of you may have found Culex or Aedes breeding. One of my inspectors insists that he has found Culex breeding in water tanks on top of an eight-story building.

Mr. Stromquist. Talking about Culex breeding on roofs of buildings, I didn't have to go up seven or eight stories. I mentioned a case yesterday where we had complaints about mosquitoes in an office building. It is one of the main office buildings in Memphis. It is built in a U shape with a court in the center. The place where they complained of mosquitoes had mezzanine windows opening on this court and there is a roof on a level with the second floor of the building, and the complaint came from the fourth floor. It was probably one of the rooms that was being used very much at night, and we found two small pools on that roof, one about 2 or 3 feet wide and about 8 feet long, and the other a little bit smaller, and in one of them we found Culex larvæ and in the other one we found no breeding at all. It was just outside of the office window and it was filled up with some cigarette butts from the office, and that may account for it, but we did find a number of cases of breeding in roof gutters.

Mr. Ropes. I might add that while we were in Arkansas we were constantly troubled with *Aedes calopus* in the capitol. The capitol, you know, is on the top of a high hill. This office was up four or five stories, and we found without any question those mosquitoes were breeding in the gutters. They must have been 100 or 125 feet from the ground, on top of a high hill.

Now, I had an experience with *Culex pipiens*. I found them breeding in two septic tanks at the Old Soldiers' Home at Mountain Creek, Ala. We promptly took measures to fill up the cracks in the tanks, so if they were breeding there they couldn't get out. It was fully two weeks before they got them out of the houses. Of course, we made no attempt to fumigate the houses or anything of that kind.

Has anyone else anything to say about Culex and their troubles with Culex mosquitoes?

It seems to me it would be a good opportunity to get some information in regard to the question of Anopheles-control periods. I think that perhaps some of you think that our control period is too short. I should like to hear from anyone who has anything to say about that.

Mr. E. B. Johnson. Mr. Chairman, I have had an experience with septic tanks at Camp McClellan. The system consisted of a series of big septic tanks. I suppose they covered a couple of city blocks. They had practically no trouble until along somewhere in September, and then the people began to move away from houses half a mile from these tanks. The city health officer sent in a call for help, and we went up there. I took a dipper such as we all use and took just a dip at the surface of the water, and got 297 wigglers in that dip. In other words, there were more wigglers than water. It was an actual fact that the tank was so full of mosquitoes it sounded like a saw. I never saw mosquitoes so thick in my life. The design of that septic tank was very good, with one exception, and that is there was no provision for draining the tank, and it took two pumps four weeks to pump that stuff out. We finally got it out and controlled the breeding, and that is the only way we could do it.

Mr. Clarke. I want to admit my ignorance of pestiferous mosquitoes or Culex. I know there are many different kinds. We haven't progressed very far in studying these pestiferous mosquitoes. I don't know whether this is very important or not, but I would like to see some publication gotten out defining the characteristics of the Culex mosquitoes, or rather the pestiferous mosquitoes, and where they may be found; that is. in simplified form. I would like to know what progress is being made along that line.

Mr. Fuchs. In answer to Mr. Clarke's question, I want to say that there is a bulletin issued by the New Jersey State entomologist, Doctor Thomas Headley, that is just what Mr. Clarke is looking for. It is illustrated and it describes the habits and characteristics of the various Culices as well as the Anopheles. I believe it may be had on application to Doctor Headley.

Doctor Bowers. In all the various discussions I have had the pleasure of listening to here, I have failed to hear mentioned the educational work done by the Rockefeller Foundation. From personal experience I have had with the research laboratory it occurs to me that if the vital statistics presented by one of the gentlemen yesterday, and various other statistics were presented to this institution, a certain definite coordinate relation could be secured from them, which would provide very many things.

One particular matter was suggested by Mr. Le Prince yesterday. This is an exhibit for the purpose of showing visitors at State fairs and other gatherings the life history of the mosquito and its development; also its potential qualification for harm.

Mr. Foster. In connection with the inquiry into what there may be in the way of unknown sources from which are derived these vexatious flies or pestiferous mosquitoes, I wish to cite to the assembly a bulletin as issued by the engineering abstracts section that came out August 20, 1921, in which it was said that certain Anopheles seem to be able to find their being and to come through to maturity in such a small film of water as to give the appearance of merely moistened earth. I bring that up to recollection. It impresses me so much because of the fact that where I work I find very many people who believe that mosquitoes, that some mosquitoes, at least, are not absolutely bound to be produced from water. It may be that we have some mosquitoes in this country which are able to breed in damp earth beneath the weeds and grass as the people so often assure us.

It is a fact that history recites that the peasantry of Italy 200 years ago attributed malaria to the mosquito—200 years ago; that is certainly long before our science bore out the beliefs of the bucolics.

Mr. Ropes. Doctor Griffitts, we would like to hear how you control the *Ædes calopus*.

Doctor Griffitts. Well, I don't know that I can go into any discussion as to how I should handle the *Ædes calopus*. In making some observations, I think during the yellow-fever campaigns—during the yellow-fever campaign back in 1903—I found them in the yards in Cairo in empty and loaded banana cars shipped through from Mobile, and they put on a regulation that no banana car could be opened outside the screened barns. Of course, it is simply a house-to-house proposition, and I think if one knows how to handle Culex mosquitoes he can handle *Ædes calopus*, or Stemogyia. He can control breeding in artificial containers around houses the same as Culex-breeding places.

Mr. CLARKE. The range of flight of the male mosquito and what bearing that would have on the finding of breeding places?

Mr. MAYNE. I think that would take into account the so-called hymeneal flight. But at certain periods they travel in swarms for the purpose of perpetuation, and I think they have different standards of migration. On that account I think it is very difficult to measure the male and female by the same standard. I can't answer more definitely.

Mr. CLARKE. I got the impression from the man from New Jersey, at the last conference, that he could approximate that the breeding places would be within 50 or 100 feet of where a number of male mosquitoes were found.

Mr. MAYNE. I don't know that any experimental work has been done on that point. I think the flight of the male is very limited. The general opinion is that the male dies very shortly after he fertilizes the female. I think that is a mistake. I have observed that they live as long as 90 days. But I believe that the male doesn't fly very far; it probably keeps very close to its breeding place.

Mr. KOMP. I think that Mr. De Mott, at the last engineers' conference, said something about mosquitoes staying near their breeding places. I am talking about Culex. In places where you find Culex in outhouses, barns, and chicken houses you will very likely find their breeding place in the same yard.

Mr. PARKER. With regard to male and female Culex; the Carnegie Institute has the books of Howard Dyar and Knob, with which we are all familiar and which deal with the question of mosquito sex. I don't remember having read anything of a specific nature regarding flight from breeding areas under various conditions, but there are incidents mentioned which indicate about how far a male Culex might be expected to go from a breeding place, as Mr. Mayne has just mentioned, in search of the female. The habits are very clearly described in these books and they contain other information of immense value regarding habits of mosquitoes.

Dr. COOGLE. It is my impression that most of us would like to have some little book or pamphlet containing the known information relative to the culicine mosquitoes common to this country, their technical and common names, and something about their habits.

I understand that such a paper has been prepared by one of the scientific workers and I would like to suggest that steps be taken to recommend the publishing of this valuable paper.

Mr. JOHNSON. Mr. Chairman, one bulletin that has been recommended is written by Dr. Thomas Headley, State entomologist of the New Jersey State Agricultural Experiment Station, at New Brunswick, N. J., Bulletin No. 348.

INTERNATIONAL HEALTH BOARD BUDGETS.

Mr. SHAW. Due to a difficulty I had at Lake Charles, Mr. Le Prince asked that I bring up the matter of the International Health Board regulations instructing us to keep within the amount allowed for each item on an estimate, whereas last year we were only required to keep within the sum total of the estimate.

My experience was this: By changing from my original plan of oil-barrel stands to motor transportation, at the end of the season I had effected a saving of $650 on an estimate of $5,588. With this saving of $650 in view at the end of September, having still a month to run, I had only $9 for oil instead of $40 or $45. I was practically without funds for oil, and yet I was $650 to the good.

I think there are two important points against making us keep within the individual item. Such will cause us to overestimate every item and probably run our whole estimate too high, whereas if we are only compelled to keep within the whole sum, when we see we are running short on one item we can probably effect a saving in another one to make up for that shortage. Or we will be inclined to stint some phase of the work in an effort to keep from several changes in the budget. It is very difficult to estimate accurately, anyhow, especially the amount of oil, because it varies so with different weather conditions. One has to be careful in the one case not to specify an insufficient amount, and in the other case, not to scare the town off on account of the high estimate.

Mr. PARKER. I think I can, in part, answer the question brought up by Mr. Shaw.

During the early part of the season I received a circular relative to changes in budgets, and the only requirement desired by the International Health Board, as I now recall it, was that changes in budgets be made before the beginning of the fourth yearly quarter.

In one of the towns where I was conducting work it became apparent, as the work progressed, that certain changes would benefit the program; this required overexpenditure of the estimated amount of certain items and produced a saving on others. I changed my item estimates to suit the change in program, not, however, exceeding the total amount of the budget, and, following the instructions in the circular, obtained approval.

Then, I believe, there is provision made so that the total amount of the budget may be changed if additional funds are required and obtained. The only restriction that I know of is that the International Health Board must be advised of any change, and before the beginning of the fourth quarter. This, I think, gives the engineer or field director authority to change his budgets when it is necessary to do so.

Mr. SHAW. I received this circular, and my understanding is that we can revise the estimate before the end of the third quarter. I do not recall any statement to the effect "preferably before the end of the third quarter." The circular gave me the impression that it was not possible to change it after the end of the third quarter.

Where I got into deep water was this: In the beginning of August I had enough oil to carry me to the end of October on the basis of the amount I used in July and August. I felt safe and thought it useless to redistribute the amounts. September was a very rainy month and we were left with only $9 for oil instead of $45. It was too late to make any change when I found the change necessary. At least we should be allowed to revise the estimate up to the end of October. It certainly ought to be satisfactory to headquarters in New York.

Mr. LENERT. I took over the work of Mr. Hardenburg in Texas in October, 1920, and in the four towns which were given financial assistance by the International Health Board individual items of the budget of three towns were exceeded, though the expenditures in all cases remained entirely within the total amount of the budget. I made an attempt to adjust the expenditures in order to fit the items of the budget by using the contingent fund for the items on oiling and inspection, but the arrangement was considered unsatisfactory by Doctor Ferrell, and I understand the expenditures as originally made were approved in that form, but notice was given that in future stricter adherence to the original budget should be observed.

In my opinion, the division of the budget into many items and a strict adherence to such a budget demands an abnormal estimate as one is required to make all items sufficiently large to cover all contingencies. If one is allowed to transfer from one item to another, the budget becomes much more flexible and makes it possible to better fit various weather conditions. Either greater latitude should be allowed or the budget should consist of fewer items.

Mr. SHAW. I wrote to the State board of health and suggested that oil and oil application were so closely related that they could be considered as one item, but in reply they quoted a very positive statement from Doctor Ferrell that it couldn't be done.

Doctor CARTER. The question has been settled. The Rockefeller Foundation has definite rules to go by, and doubtless goes by them. What ought to be done, plainly, is this: A definite sum to be set apart for a definite work, or, more accurately, for the work for a definite purpose; e. g., to control malaria at ———————. The detailed allotment for each item of that work should not be obligatory on the engineer in charge. These items are necessary in making the budget; they should be guides, maybe, but not hard and fast rules governing expenditure. Circumstances, the weather, for instance, change the amount needed for the various items, and frequently as the amount for one increases that for another lessens and the engineer can both do more efficient work and save money by increasing expenditure on one item and lessening it in another, and for good administration he must have this authority.

Otherwise, you compel him to estimate for every item at its reasonable maximum. He must either do this or run a grave chance of failure. This makes an unnecessarily large budget. I have invariably followed this plan in making my own budget, both for myself and for other people.

Mr. Stromquist. I think another point is that the tendency to make an excessive budget would also have the tendency to discourage the community from taking up the work. In my limited experience in making up a budget for the cooperative work the procedure was to make a survey of the work and a rough estimate of what it would cost. Then compare that with what I thought the town could put up. After I got the appropriation I tried to get the work done with that.

Oil.

Mr. Foster. It occurs to me to mention a supposed improvement in oil application, the novel technique, as will be mentioned, having been devised to meet the presumed condition that in the quite warm months many larvæ do not bask at surface extensively, but frequently remain at the bottom for hours at a time, such supposed habit leading to the situation which has been observed that where oil is applied to ditches having even a mild current, many larvæ never encounter the film from a single application of oil. The teaching from these observations was that the oiler should wear boots and that he should get in the water course and walk downstream, grass cutting at margins with a hoe or with a handsaw slice tool, the purpose being to agitate the water and to rout out the semidormant larvæ. After this the oiler works upstream, spraying the route as usual. It was thought to have been well shown that oiling done quite early in the morning was much more effective than work done in the "heat" of the day.

Mr. Stromquist. I might mention my experience this summer with the use of waste oil. In Memphis last year they used about 10,000 gallons of oil at a total cost of $1,700; this year our oil was something less than $700. Of course, the price of oil has been reduced, but the same kind of oil that cost, some of it 17½ cents, the most of it 16½ cents, I think would now cost 11 or 12. Our average cost of oil has been about 7 cents. We have bought a good deal of kerosene, which we used to dilute the heavier oil, but we have accumulated a good deal of oil from the garages, filling stations, and other places. For instance, the gas and electric company sold us for 5 cents a gallon about 2,000 gallons of used transmitter oil, which is a very high grade of oil. It cost them new about 27 cents a gallon in carloads, and it makes a very good oil for spraying. It doesn't require very much kerosene to dilute it enough to spray, and it will kill both Anopheles and Culex larvæ even without the kerosene.

I have been keeping in touch with people to get the kerosene at a low price. For instance, the Standard Oil Co. sold us about 4,000 gallons of kerosene that had been drained out of the bottom of some large storage tanks and had gotten discolored, had a little sediment, and they said some water, but we found very little of that, and they wanted to get rid of that, to get their storage space, and another oil company by mistake dumped several hundred gallons of oil into a tank that had lubricating oil in it, so we bought about a 300-gallon tank. I have a number of barrels placed around town, collecting oil during the winter months that people want us to take off their hands. Of course, we will have to buy kerosene to dilute that with.

Mr. E. B. Johnson. While we are on that subject, I have been very fortunate in getting oil from the garages for nothing. I think there is just one town where we pay anything for it.

Mr. Komp. Two months or so ago I was in Anniston, where Camp McClellan is located. All the fire barrels there were covered with a thin film of black substance. On inquiry it was found that it was the Texas Co.'s mosquito oil. It was stated that it had been on the barrels since about July 26, or approximately three months, during the hottest weather. There wasn't a bit of breeding in any of those barrels at that camp. I don't know whether Mr. Johnson found any breeding or not. That black mosquito oil looked good to me.

Mr. Johnson. When were you there?

Mr. Komp. During the latter part of October.

Mr. Johnson. We had previously found very heavy breeding in this place, and it was as a result of our visit that they oiled.

Mr. Komp. Were any of the barrels oiled at the time of your visit?

Mr. Johnson. Not one. About all that we saw were breeding.

Mr. Komp. I would like to know from some of the men just what mixture they have gotten the best results from.

Mr. Ropes. I am sorry that we have not been able to have with us Lieutenant Freeborn. He was a lieutenant when I knew him. I know that he knows more about the general toxic value of oil than any man I have met.

There is no doubt but that some of these oils are worth absolutely nothing. Last year I had a species of black lubricating oil. It had no toxic effect whatever. We had to dilute it with kerosene to use it, and the only thing that killed the mosquitoes was the kerosene. When we used this oil it had no effect whatever on *Culex pipiens*. I think when we take oil like that we should be very sure that we are getting something of value.

Mr. STROMQUIST. We tested our oil before we bought it. One of the inspectors had just run across a little pool that had Anopheles and Culex larvæ in it, and we sent him out to make a collection. I put larvæ in two jars, and in one I put the transformer oil unmixed and in the other I mixed it with about a third kerosene, and in both of them the larvæ were all dead in about 30 minutes and it made a very nice oil to spray.

Mr. ROPES. Did you try any of the oil alone?

Mr. STROMQUIST. Yes; I took two jars and put the transformer oil in one and the mixed oil in the other.

Mr. ROPES. What I want to know is whether you got results from a 50-50 mixture?

Mr. STROMQUIST. We did get a few barrels of black oil which was so heavy, in a 50-gallon drum, that we had to use 50 gallons of kerosene.

Mr. ROPES. I used a mixture of 80 to 20 with some, and found that was the best mixture.

Mr. STROMQUIST. Ordinarily I should say we have used about a third to a half of kerosene on our work.

Mr. KOMP. The principle of the thing, as shown by Professor Freeborn, is that the volatility of the oil is an index of its toxic properties. That is the reason that the heavier oil is not much good so far as killing the larvæ is concerned. The kerosene is what gives toxicity to the mixture.

Doctor CARTER. It is a matter of hours for Stemogyia. In a test we kept the Stemogyia under water for 12 hours and at the end of the day they were as well as they were in the beginning; they got as much oxygen as they needed from the water. Anopheles don't last so long. Oil, coal oil, kills them directly by contact.

Doctor COOGLE. In case oils are used that do not have toxic effect, is it true that the most we hope for is to prevent mosquito eggs from hatching? I should like to know approximately the maximum size larvæ, both Anopheline and Culicine, we would expect to destroy by using a thin film of nontoxic oil?

Doctor CARTER. It destroys small larvæ. I feel very certain that oil will prevent eggs from hatching. Even greasing a hen's egg will keep it from hatching.

Mr. SMITH. My conception of the use of black oil is for a vehicle only, and I find that in cold weather this oil breaks up in large globules when used 50–50, but when it is mixed 80–20 it gives much better results.

ARTESIAN WELLS.

Mr. **CLARKE.** I want to take up the matter of control of artesian wells which are allowed to run, unchecked, in the Southern States. I believe if these wells were controlled that it would not only help out in the cities—that is, eliminate the street pools and water in borrow pits—but that it would help the farmer in the rural district.

Now, in the Mississippi Delta, the general formation of the country lends itself to the detriment of this flowing of artesian wells, because the general slope is away from the big streams. The big streams have high banks and the general ground slope is away from the large streams in all cases, and in the case of small cities, to a certain extent, we can reverse the flow of water by cutting through this bank, but if we want to pave the way for the general development of that town we will have to, eventually, carry the drainage the other way. It has a certain turning point where you can reverse the flow of water, but beyond that you have to take care of it in its natural channel, and in a great many cases in so doing, do away entirely with mosquito breeding. After the ground water lowers itself in the spring, the soil will take care of the rainfall during the summer months within five or six days.

So, in order to get at this matter of control of artesian wells on a broad scale, we have got to have some legislation. The public-health factor might be taken advantage of and included in such a law to control artesian wells for the purpose of conserving the ground-water supply. We know in certain localities where a number of wells have been drilled that each additional well reduces the pressure of the older wells, and while it isn't very important now in the Delta of Mississippi, because the Delta is fed by water seeping down from the hill section, it will be necessary to conserve that flow when the Delta builds up. We might just as well start the movement now on a general plan immediately, and let the State geologist prepare such a bill, and then we should get back of it and help put it through. His purpose would be to conserve the flow of water and our purpose would be to eliminate mosquito-breeding places. I would like to hear from somebody else as to the feasibility of that.

Mr. **KROEZE.** Mr. Chairman, it is said that something destroys the well—that sand clogs it, due to external or back pressure or something like that. I don't know just what it is. A large number of towns in Mississippi have artesian wells for their water supplies. These wells flow into reservoirs and water is pumped from there to the distribution system. They have gate valves on the wells and shut them off when the reservoirs are full instead of allowing the water to flow away and breed mosquitoes. They have been doing this for a number of years and I haven't noticed any effect on the wells.

You will hear that argument that it has an effect on the wells, but I don't think it has.

Mr. Magoon. Mr. Chairman, there is some chance that when the water is shut off it will continue to flow around the casing of the artesian well, and the well may be spoiled in that way. I mention that because I know of one instance where that did happen. The well, I think, was about 90 or 100 feet deep and the choking of its flow caused the water to find another outlet.

Mr. Clarke. I might add that the general impression is that these wells will become choked, and I am taking this up with our State geologist, who has shown me that in the State of Mississippi there is very slight possibility of their becoming choked, especially of those wells which are properly dug.

The requirements should be, of course, that they should be screened at the bottom and cased all the way up, and the well which is properly constructed will not silt up. When you have a slight throw of sand in your well certain precautions will have to be taken; you should put on a top and a patent spigot, and in those cases we can put on just an ordinary faucet. Put on your reducer and put on a standard screw faucet, which will turn the water off and on gradually, and use it as you would any other gravity system.

I have other data from the United States Geological Survey and from South Dakota. Such a law as I speak of has been passed in either North or South Dakota, in California, and New Mexico. You see some of the States are not populated thickly enough to warrant it at the present time. They are coming to it and I think we should be prepared to meet the situation when it comes.

Mr. Foster. I move that we adjourn and pay our respects to Doctor Carter.

Whereupon the meeting adjourned.

Cost of first and second year Anopheles-control work in cooperative towns.

State.	Number of towns.	Square miles controlled.	Population protected.	First-year cost (1920).		Second-year cost (1921).			Second year's cost compared with first.
				Per capita.	Per square mile.	Total.	Per capita.	Per square mile.	
									Per cent.
Alabama	5	22.0	26,057	$0.57	$672.55	$5,292.28	$0.20	$240.55	36
Arkansas	3	11.5	11,361	.60	590.84	3,550.00	.31	308.70	52
Louisana	1	4.42	21,782	.22	1,080.00	[1] 3,500.00	.16	791.85	[1] 73
Georgia	2	20.5	19,751	.43	411.53	5,310.00	.27	259.02	63
Mississippi	5	13.3	20,024	.55	836.00	1,799.87	.09	135.32	16
North Carolina	8	11.0	19,100	1.25	2,180.00	8,055.05	.42	782.28	34
South Carolina	3	22.5	10,311	3.93	1,800.00	10,360.25	1.00	460.45	26
Tennessee	1	5.1	6,544	.36	465.00	366.00	.06	71.76	15
Texas	11	38.0	28,947	.59	447.00	2,063.32	.07	54.30	12
Virginia	1	.6	1,635	2.22	6,050.00	896.58	.55	1,494.30	25
Total	35	148.9	165,712	.81	896.00	41,173.35	.25	276.52	31

[1] Estimated.

TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 126

LIBRARY OF
S H. OSBORN M. D.

TRANSACTIONS

OF THE
CONFERENCE ON

THE FUTURE OF PUBLIC HEALTH IN THE UNITED STATES

AND THE

EDUCATION OF SANITARIANS

NOV 7 - 1937

HELD AT WASHINGTON, D. C.
MARCH 14 AND 15, 1922
Under the Auspices of
THE UNITED STATES PUBLIC HEALTH SERVICE

WASHINGTON
GOVERNMENT PRINTING OFFICE
1922

TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 126

TRANSACTIONS
OF THE
CONFERENCE ON

THE FUTURE OF PUBLIC HEALTH IN THE UNITED STATES
AND THE
EDUCATION OF SANITARIANS

HELD AT WASHINGTON, D. C.
MARCH 14 AND 15, 1922
Under the Auspices of
THE UNITED STATES PUBLIC HEALTH SERVICE

WASHINGTON
GOVERNMENT PRINTING OFFICE
1922

PROGRAM OF THE CONFERENCE.

Morning Session, March 14, 1922.

Page.
Introductory address—Hugh S. Cumming 1
Remarks by the presiding officer—William H. Welch 2
I. The present status of the education of sanitarians:
  1. Review of events leading to the present situation—Allen W. Freeman 3
  2. The present status of education for a public-health career—Milton J. Rosenau 8
  3. The 1922 Congress on Medical Education, Medical Licensure, Public Health, and Hospitals and its conclusions regarding the education of sanitarians—Frederick R. Green 23
II. Newer aspects of public health and their importance in training of sanitarians:
  1. Mental hygiene—William A. White 26
  2. Child hygiene—Richard M. Smith 29
  3. Economic and sociological aspects of public health—Lee K. Frankel. 32
  4. Physical education—Jesse F. Williams 38
  5. Industrial hygiene—Otto P. Geier 42
  6. Public-health education—Carl E. Seashore 46
    Discussion—
      Mazyck P. Ravenel 50
      Willard S. Small 51
      Donald B. Armstrong 53
      Hermann M. Biggs 53
      George M. Kober 54
      Alexander C. Abbott 56

Afternoon Session, March 14, 1922.

Remarks by the presiding officer—Hubert Work 57
III. What kind of sanitarians are needed for the future?
  1. Into what specialized fields will public-health work be differentiated in the future, and in what colleges and professional schools will men for these various fields be trained?—C.-E. A. Winslow 59
  2. What kind of men will be needed in the local health unit in bringing public health to the "ultimate consumer"?—Walter H. Brown 64
  3. What kind of men will be needed in the State department of health, especially for the larger administrative tasks?—A. J. McLaughlin. 67
  4. What kind of men will be needed for research?—A. M. Stimson 70
    Discussion—
      Vernon Kellogg 74
      William H. Park 75

IV. How may more and better sanitarians be recruited? Page.

1. Reasons given by medical students for not entering schools of public health and public-health work—E. O. Jordan.................... 76
2. How can the career of the sanitarian be made more attractive? John A. Ferrell.. 81

Discussion—

Frank J. Goodnow.............................. 86
L. L. Lumsden.................................... 89

Morning Session, March 15, 1922.

Remarks by the presiding officer—Hugh Cabot.................................. 92

V. How shall the sanitarians of the future be trained?

1. What may the universities of the United States do through their various colleges to meet the need for more and better trained sanitarians?—James R. Angell.................................. 92
2. A proposed curriculum for a school of public health—George C. Whipple.. 99

Discussion—

Victor C. Vaughan.................................. 106
Annie Goodrich.................................... 109
A. C. Abbott... 113
3. The education of the partially-trained sanitarian now employed—Roger Perkins.. 115

Discussion—

Eugene Kelley.................................... 122
S. J. Crumbine.................................... 125

Afternoon Session, March 15, 1922.

Remarks by the presiding officer—Frank J. Goodnow.......................... 127

VI. Round Table:

First question: How may practical opportunities for field work be provided for the students in public-health schools?

Haven Emerson.. 127
W. C. White... 128
William F. Snow...................................... 130
H. R. Carter.. 130
G. B. Young.. 131
William H. Welch...................................... 132
O. P. Geier.. 134
A. T. McCormack...................................... 135

Second question: What specific steps may be taken to bring before college students in general and medical students in particular the opportunities for service in public-health work?

George M. Kober.. 136
William Keiller.. 136
D. W. Davis... 137
Charles W. Stiles....................................... 138
Louis I. Dublin.. 138
Robert Wilson, jr.. 140
John Milton Dodson.................................... 140

VII. Concluding addresses:

1. The university of the future—A recruiting and training center for the public-health professions—Ray Lyman Wilbur.............. 141
2. Public health and the future commonwealth—Lewellys F. Barker.. 143
3. Recapitulation—David L. Edsall.................................. 148
4. Report of committee on recommendations.......................... 153

CONFERENCE ON THE FUTURE OF PUBLIC HEALTH IN THE UNITED STATES AND THE EDUCATION OF SANITARIANS.[1]

THE CONFERENCE.

MORNING SESSION, MARCH 14, 1922.

INTRODUCTORY ADDRESS.

HUGH S. CUMMING, *Surgeon General, United States Public Health Service.*

It was not without a good deal of hesitation and thought and some preliminary correspondence that I ventured to ask such gentlemen as you to leave your work, your fields of endeavor, and meet here in Washington with us. I am very acutely conscious of the fact that there has been quite an epidemic of "conferencitis," as somebody expressed it, in the past year or two, and that much of the time of all of you has been taken up in conferences. But I think the importance of the subject which you have been asked to discuss certainly warrants our getting together for at least two days.

This is, so far as I am aware, the first time at which exactly this sort of a gathering has been called—the presidents of universities and deans of medical schools to meet around a conference table with men who are engaged in practical field work in public health. The situation in the United States at the present time with reference to the supply of public-health officers—local, State, and National—is an acute one. As a result of the war and the knowledge which was brought out at the time, there has been a great awakening of interest in public health throughout the country. This necessitates the training of public-health workers to direct the energies and the potential forces which are available. Without proper directing force, there is grave danger of wasted energy. This has already been seen in certain fields. It is to avoid this danger and to supply the man for the job that we venture to ask you to come together.

I am perfectly aware of the fact that there are splendid schools of public health existing now and they are encouraging. But more particularly the field of the local health officer needs to be filled. There are three factors in this situation. One is the difficulty of the local man in getting the amount of education necessary for his work. Another, and I think this exceedingly important, is the uncertain tenure of office. There has been, if anything, a backward step in the last ten or eighteen months in this regard; a tendency to throw public health into politics in a way to pay, but in a different sense than we think it pays. The third difficulty is the inadequate remuneration which is received by the public-health officer. We will discuss all of these things, and, I hope, solve one or two.

---

[1] A conference on the future of public health in the United States and the education of sanitarians was held in Washington March 14 and 15, 1922. Nearly 150 educators and leaders in public-health work from all sections of the country attended. All sessions with the exception of the banquet were held in the American Red Cross Building. A summary report of the conference has already been published (Public Health Bulletin No. 124, May, 1922.)

In looking around for a man to guide us in our deliberations, my mind at once went to one whom we all know, one who needs no introduction. I have found that he is a wise guide, whether it be looking over a menu for a dinner or solving very great international questions in reference to public health. I take a great deal of pleasure in introducing Doctor Welch, director of the Johns Hopkins University School of Hygiene and Public Health.

REMARKS BY THE PRESIDING OFFICER.

DR. WILLIAM H. WELCH, *Director School of Hygiene and Public Health, Johns Hopkins University.*

I need not say that I appreciate very highly the honor of being asked to occupy the chair at this first session of the conference. I am sure that I shall serve your interests best by not indulging in any preliminary remarks but by getting the work under way as speedily as possible. I would like, however, to express in behalf of the staff of the Johns Hopkins University and myself our appreciation, our very grateful appreciation, to the Surgeon General and the officers of the Public Health Service for having made me chairman for this conference, and for the general spirit which obviously has determined the character of the conference.

I am speaking for those engaged in trying to develop better opportunities for the training of public-health officers and others entering the field of sanitation and public health. We welcome very much such a discussion as will take place here. The problems are relatively new and we are in a rather experimental stage. It is of first importance that attention be very closely given to those who are actually at work in the field, and it is important that there should be just such an exchange of views as can be anticipated for this conference. I already feel confident of the success of the conference and do not hesitate, even at its initiation, to express the gratitude which we have for the opportunity which is before us.

It is obvious, if we are going to get through this program this morning, that the speakers must be as brief as possible. I asked one of them whether he had been informed as to time limit; he said he had not, but was willing to conform to whatever suggestions were made. I have no suggestion other than that we have to split up just as much as possible if all the speakers on the program are to have an opportunity to present what they have presumably prepared for our consideration.

I. THE PRESENT STATUS OF THE EDUCATION OF SANITARIANS.

REVIEW OF EVENTS LEADING TO THE PRESENT SITUATION.

Dr. Allen W. Freeman, School of Hygiene and Public Health, Johns Hopkins University.

Prior to the middle of the last century medical science, if we may so call it, had made possible the prevention of only one disease—smallpox. In connection with no other disease was the etiology, diagnosis, and means of spread sufficiently well understood to make possible any thoughtful effort at prevention.

About 1850, however, the effect of the unspeakable filth, overcrowding, and misery of certain parts of London in producing disease and death far in excess of that prevailing in more favored parts of the city began to be recognized. Even though the exact mechanism by which these causes operated was not understood, the results were so evident that measures of correction began to be applied.

About the same time those two pioneers in epidemiology, William Budd and John Snow, began independently their remarkable studies into the spread of typhoid fever and Asiatic cholera which made possible for the first time intelligent efforts at the control of these diseases.

The 30 years from 1870 to about 1900, the most fruitful in the history of medical science, stripped from communicable disease the mystery which had so long enshrouded it and laid the foundation of scientific fact on which the structure of preventive medicine is based. Knowledge of microorganisms as causing disease, of the vehicles of transmission, of carrier and missed cases, of insect transmission, and of the phenomena of natural and artificial immunity were the weapons which this period forged and made ready for the coming conflict.

The new century, therefore, found us in possession of a new and effective armentarium. It remained only to demonstrate practically the possibilities of the new science and to establish the machinery necessary to make its practical application possible. The demonstration came quickly. Gorgas at Habana and later in Panama, and the Japanese in Manchuria, supplied those thrilling demonstrations of the power of modern science over disease which were necessary to fire the imagination of the people and supply the stimulus to action.

Of machinery to apply the new science there were available only the time-honored organizations known as boards of health, which had been devised in the last half of the last century, to apply the then existing knowledge of disease prevention.

Originally boards of health were called into existence during periods of epidemics of smallpox, cholera, yellow fever, or plague. Their sole function was to act as medical consultants to the public authority in such emergencies. With the passing of the emergency the board likewise passed. When vaccination had reduced the prevalence and virulence of smallpox to the point where isolation and quarantine were of value in preventing epidemics, the work of caring for smallpox was taken over by the boards of health, and permanent organizations began to be established. The measures against filth and overcrowding, in so far as they were applicable to American conditions, were likewise made the duty of the board of health. In Massachusetts, in the city of New York, and in a few other States and cities the value of the new science had already been recognized, and important work had already been done by the health organizations in connection with water supply, communicable diseases, tuberculosis, and other problems.

The beginning of the century, therefore, found in most of our States and cities, and in many of our counties and towns, boards of health. These were usually composed of practicing physicians, of whom one acted as secretary. Their work in controlling smallpox and nuisance was largely intrusted to lay inspectors called sanitary police. The measures carried out by such a board of health were extremely simple, and the work called for little or no special knowledge or experience. Under these conditions an appointment as member of a board, as secretary or inspector, was usually disposed of as minor political patronage. This was the machinery available to put into effect our new science of preventive medicine. It had in its favor the fact that it was under the control of physicians and that the word "health" occurred in the title.

With the beginning of the new century began the attack on consumption, causing at that time one-seventh of all deaths and one-third of those between the ages of 20 to 30. Controlling consumption was no task for a sanitary policeman or a part-time practicing physician. For success it required accurate, detailed, scientific method. It required coordinated clinical, preventive, and social measures. It required clinics, hospitals, nurses, social workers, physicians, and educators. The hopelessness of expecting the then existing boards of health to conduct such work was so manifest that voluntary agencies were created to carry it on, and even where it was financed by public funds agencies separate and distinct from the board of health were set up to do tuberculosis work alone.

The 20 years just gone have seen one after another of the major problems of public health taken up and made the objects of sustained and successful attack. Typhoid fever, infant mortality, diphtheria, scarlet fever, hookworm disease, malaria, and finally venereal disease have been successfully added to the program of prevention. Each of these problems has required the development of new methods of attack, differing radically from the simple procedures of quarantine, disinfection, and inspection of the former era. For the successful control of malaria, for example, thorough knowledge is required not only of the disease and of its etiologic agent as it exists in the human host but of its intermediary host, the mosquito, and of all the complicated factors which govern the prevalence and distribution of those species which spread the disease. The "malaria engineer," as he is now designated, is at once a protozoologist and entomologist, icthyologist, botanist, and hydraulic engineer. For the control of diphtheria, once involving only quarantine of the premises where the case is found and subsequent disinfection, there is now required the combined services of the epidemiologist and the public-health nurse working in the field and the bacteriologist and the serologist in the laboratory.

To meet the new needs and to supply the new services our official health agencies have undergone complete metamorphosis. Quarantine, fumigation, and sanitary inspection, once their only function, have become minor activities. The laboratory, the clinic, the epidemiologist, the nurse, and the social worker carry on the real work of a health department to-day.

The health officer is no longer a practicing physician, dropping in for half an hour in the morning to look over the mail and see that the clerk is running things properly. He is a whole-time executive, spending tens or hundreds of thousands of dollars a year and having under his control scores, hundreds, or thousands of employees. His task is exceedingly difficult. The science he has to apply is very extensive, highly specialized, and constantly expanding. The Government of which he is a part and through which he must work is cumbersome, beset by partisan politics and hampered by red tape. The people he serves are in large part ignorant of the purpose and method of health work, are suspicious, sensitive, and inclined to resent interference with established habits and customs.

In spite of all these handicaps, our State, city, and county health departments have responded nobly to the heavy demands made upon them and have adapted themselves surprisingly well to the changed conditions of their operation. There has developed a class of professional sanitarians who, drawn into health work without training, have evolved the technique and brought the subject to its present state of development.

The actual growth in our health organization may perhaps best be seen through a study of existing personnel and expenditures.

Estimate of technical and semitechnical personnel engaged in health work on whole-time basis, 1920–1921.

Principal executives:			
State health officers	42		
City health officers	267		
County health officers	161	470	
Subordinate executives:			
Employed by States	250		
Employed by cities	250	500	
Total whole-time executives employed by States, cities, and counties		970	
Officers of United States Public Health Service engaged in public-health work (about)		200	
Total physicians at present employed in whole-time health work by public agencies			1,170
Public health nurses employed by public agencies (estimated)			5,000
Plumbing, sanitary, dairy, and food inspectors			3,000
Laboratory workers, State		200	
Laboratory workers, city		1,000	1,200
Total			10,370

To this number must be added the very large number of physicians, nurses, and other health workers employed by voluntary agencies of one sort or another, and by industrial concerns. This would include at least 500 physicians and 5,000 nurses. An additional number, of which no estimate is available, are employed by schools, colleges, and universities.

Taking the sum of medical, engineering, statistical, laboratory, nursing, and inspectional personnel, therefore, there are approximately 16,000 persons occupying whole-time technical or semitechnical positions in health service in the United States.

The annual expenditures by the States, cities, and counties, based on 1920 figures, may be estimated as follows:

States	$10,000,000
Cities	20,000,000
Counties, towns, and villages	5,000,000
Total	35,000,000

Of this amount, about 75 per cent is expended for personal services.

TRAINING FOR HEALTH WORK.

To spend thirty-five millions of dollars a year wisely and effectively and to direct the labor of 16,000 people in the practical application to human affairs of a science so new and in some of its phases so frankly experimental as is preventive medicine at this time makes heavy demands upon the scientific and administrative ability of those responsible for the conduct of the undertaking.

Of those at present in charge of our health departments but few have had any training in preventive medicine prior to entering the work other than that possessed by the ordinary physician.

Definite information is available regarding two groups of executives. In 72 of the cities of the United States having a population of 100,000 and over, a survey was recently conducted by a committee of the American Public Health Association, and accurate information is at hand regarding the qualifications of these executives. In addition, some information is available regarding the principal and subordinate executives of the State health organizations of the country.

For the executives of the 72 cities referred to we have the following information:

Education and training of executives of 72 municipal health departments in American cities of 100,000 population and over.

	Number.	Per cent.
A. Health officers having neither college nor professional training	5	7.0
B. Health officers having medical training only	27	37.5
C. Health officers having college and medical training	28	38.9
D. Health officers having college, medical, and public-health training[2]	9	12.5
E. Health officers having college, engineering, and public-health training[3]	3	4.1
	72	100.0

For the group of State executives we have the following information:

Professional training of 342 principal and subordinate executive officers in State health departments.

	Number.	Per cent.
Physicians with medical training only	199	58.2
Physicians with medical and public-health training[4]	2	.6
Public-health training[5]	3	.9
Engineers	31	9.0
Nurses	16	4.7
Laboratory and miscellaneous	91	26.6
Total	342	100.0

For the whole group, municipal and State, we have 265 physicians in executive positions, of whom 11, or 4.2 per cent, have had some special training in public health and of whom 5, or 1.9 per cent, possess degrees in public health. In addition, there are 6 executives who have general training in public health but who are not physicians. A large majority of the engineers, nurses, and laboratory workers who are employed by departments of health have had special training in those technical branches of the subject.

---

[2] Three possess degree of Dr. P. H.

[3] One degree of Dr. P. H.

[4] One Dr. P. H., one M. P. H

[5] One C. P. H., one D. P. H., one B. S.

Taking principal executives only, we have for the 72 cities and the 48 States the following figures:

Professional Training of 72 Municipal and 48 State Executives, Heads of Departments.

	Number.	Per cent.
Physicians without public-health training	101	84.2
Physicians with public-health training	10	8.3
Engineers with public-health training	3	2.5
Laymen without professional training	6	5.0
Total	120	100.0

From the standpoint of general administration, therefore, 92.5 per cent of the health departments studied are administered by physicians of whom 9 per cent have had special training. Two and one-half per cent are administered by engineers with special training and 5 per cent by laymen without any training whatever.

Of the 294 subordinate executives, 153, or 52.1 per cent, are physicians of whom only 1 has apparently had special training in public health.

The first generation of sanitarians were, of course, necessarily self-taught. Many of them are still in active service, and to their intelligence, devotion, and energy is largely due the present development of our health organizations. It is with the second generation, the men who are to be the executives of the next few decades, that we are concerned. It is to the subject of their training that we should devote our deliberations.

THE PRESENT STATUS OF EDUCATION FOR A PUBLIC-HEALTH CAREER.

Dr. MILTON J. ROSENAU, *Professor of Preventive Medicine and Hygiene, Harvard Medical School.*

The present status of education for a public-health career is in a formative and experimental stage. A glance at the situation at once discloses the fact that it is only the morning of the first day. There is only one school separately endowed, namely, the School of Hygiene and Public Health at Johns Hopkins, which is now in the third year of its existence. Through the generosity of the Rockefeller Foundation, another school of public health which is now being organized at Harvard University will open its doors in the autumn. The Harvard School of Public Health is an outgrowth, in fact a direct continuation, of the School of Public Health of Harvard University and the Massachusetts Institute of Technology, which was organized in 1913.

The youthfulness of the present movement in education for public-health service is betrayed by a brief historical review of a few leading facts. The University of Pennsylvania announced courses leading to a degree or certificate in public health in 1906, but the first of these awards was not made until 1912. Prior to this time (June 22, 1910), the Harvard Medical School offered the degree of doctor of public health and the first student was graduated with this degree in June, 1911. The School of Public Health of Harvard University and the Massachusetts Institute of Technology was opened in September, 1913, and the first class was graduated in June, 1914. Long before any medical school offered courses or degrees in public health, the Massachusetts Institute of Technology trained men and women for careers in sanitation in its department of Biology and Public Health, under the pioneer efforts of Prof. William T. Sedgwick.

This little historical statement with dates is given in order to emphasize how recent education for public-health service is. Young as the movement is, however, this country seems to have taken the lead in establishing separate schools and in organizing courses designed specifically for the training of health officers. Before this the only school was the school of experience.

THE STATUS IN 1920.

The status of public-health education in this country for the year 1920 was studied by a committee of the American Public Health Association which dealt with the standardization of public health training. The report was published in the American Journal of Public Health, April, 1921, page 371.[6] We learn from the studies of this committee that in the year 1920 (academic year 1919–20), public health degrees of one sort or another were conferred at California, Yale, Hopkins, Harvard, the Massachusetts Institute of Technology, New York University-Bellevue, and the University of Pennsylvania. Courses dealing with public-health education were discontinued in 1920 by the University of Colorado and by Tulane University.

Although courses were offered by the Detroit College of Medicine and Surgery, the University of Michigan Medical School, and the University of Wisconsin, no students were registered or graduated during the year in question. Special courses for health officers leading to certificates and degrees in public health were in successful operation at Syracuse, cooperating with Cornell, and at Louisville, where the State department of health cooperates with the University of Louisville.

---

[6] An earlier survey of the status of public-health education was collected by Dr. E. C. Howe, in the American Journal of Public Health, August, 1918, and partial data had been presented for several years by the Council on Medical Education of the American Medical Association; see the Journal of the A. M. A., Aug. 7 ,1920 ,and Aug. 13, 1921.

The following table is modified from that published in the report of the committee of the American Public Health Association, the changes being due to more recent information:

TABLE I.—*Number enrolled and degrees conferred in courses leading to a public health career in 1920.*

University.	Degree.	Time required.	Number graduated.	Number of instructors.
University of California	Gr. P. H.	1½ to 4 years	10	20
Yale University	Dr. P. H.	2 years	2	Staff.
	C. P. H., Ph. D., and M. S.	1 year	2	
Johns Hopkins	Dr. P. H.	2 years	2	49
	Dr. Sc. (in Hyg.)	3 years	1	49
	B. S. (in Hyg.)	2 years	1	49
	C. P. H.	1 year	0	49
Harvard Medical School	Dr. P. H.	2 years	2	Staff.
Harvard—Technology	C. P. H.	1 year	9	40
Harvard University	Ph. D. (in Hyg.)	3 years	0	Staff.
Massachusetts Institute of Technology.	B. S.	4 years	10	Staff.
	M. S.	5 years	1	
Detroit College of Medicine and Surgery.	M. P. H.	1 year	0	10
University of Louisville and State department of health.	Dr. P. H.	2 years	0	Staff.
	C. P. H.	1 year	2	
University of Michigan Medical School.	M. S. (in P. H.)	1 to 2 years	0	10
	Dr. P. H.	2 to 3 years	0	10
New York University and Bellevue Hospital Medical College.	do	2 years	0	30
	C. P. H.	25 days residence, or, 300 hours reading plus 6 days residence.	25	30
Syracuse University	Certificate	Special courses for health officers to meet requirements of New York State.	....	
Albany Medical College	do	6 weeks correspondence and 1 week attendance.	....	
Ohio State University	M. S. (in P. H.)	1 year	....	
University of Pennsylvania	Dr. P. H.	2 years	1	19
	Certified sanitarian	1 year	4	19
University of Wisconsin	M. P. H.	1 year	....	
	Dr. P. H.	2 years	....	

NOTE.—Special students are omitted in this tabulation. Public-health nursing is not included.

From this table it will be seen that 72 public-health degrees were conferred by 9 institutions during the year 1920, as follows:

Certificate in public health	38
Certified sanitarian	4
Graduate in public health	10
Bachelor of science (in hygiene)	11
Master of science (in hygiene)	1
Doctor of science (in hygiene)	1
Doctor of public health	7
	72

Public-health nursing.—Courses and opportunities for training in public-health nursing are omitted from this discussion. The education of the public-health nurse is dealt with as a separate problem. To inject it into this survey would only add confusion to our present purpose. In my judgment, however, this separation serves no useful purpose, for it should be the function of a school of public health to include facilities for adequate training in this profession.

The public-health nurse is an admirable instrument of direct contact with the individual. She sells health and hygiene to the ultimate consumer. There has long been a wide gap between the health officer and the individual he serves. This is bridged by the public-health nurse, who has become one of the important links in the chain of good-health administration.

THE STATUS IN 1921.

The following table is made up from information obtained by sending out a questionnaire to all schools known to be interested in the subject:

TABLE II.—*Number enrolled and degrees conferred in courses leading to a public-health career in 1921.*

University.	Degree.	Number Enrolled.	Number graduated.
University of California	A. B. (majoring in public health, bacteriology, medical entomology, parasitology, nutrition).	28	....
	B. S. (majoring in sanitary engineering)	2	....
Yale University	Dr. P. H.	1	0
	C. P. H.	3	1
	M. S. (in Bact. and P. H.)	6	2
	Ph. D. (in Bact. and P. H.)	6	3
Johns Hopkins	Dr. P. H.	22	14
	Dr. S. (in Hyg.)	21	1
	B. S. (in Hyg.)	9	4
	C. P. H.	4	6
Harvard Medical School	Dr. P. H.	2	2
Harvard—Technology	C. P. H.	24	16
	C. P. H. (in Ind. Hyg.)	3	0
Massachusetts Institute of Technology.	Biol. and P. H.	35	[1] 7
	San. Eng.	15	[2] 1
University of Louisville and State department health.	Dr. P. H.	0	0
	C. P. H.	2	2
University of Michigan	M. S. (in P. H.)	3	2
New York University—Bellevue.	C. P. H.:		
	25 days' residence	18	40
	Correspondence course	22	....
	Dr. P. H.	1	0
Syracuse University	Certificate (special courses for health officers; 13 took course at Cornell and 10 at Syracuse).	23	....
University of Pennsylvania[3]	M. S. or Ph. D. (in Hyg.)	6	....
	C. S. or Dr. P. H.	6	5

[1] B. S. (in P. H.).

[2] Ph. D. (in P. H.).

[3] In addition, 14 students in the college, school of education, and the graduate school are given courses in bacteriology in relation to sanitation, domestic sciences and industry; and 50 students from the Towne Scientific School are given courses in bacteriology in relation to biology, sanitary engineering, and the sanitary supervision of contractors' camps.

NOTE.—Special students are not included in this tabulation. Public health nursing is omitted.

In 1921, then, a total of 106 public-health degrees of various sorts were conferred by 9 institutions:

Certificate in public health	65
Bachelor of science (in hygiene)	11
Master of science (in hygiene)	4
Doctor of science (in hygiene)	1
Doctor of philosophy (in hygiene)	4
Doctor of public health	21
Total	106

This information from recent correspondence is approximately correct, although probably not complete. The difficulty of tabulating the present status in any uniform scheme of arrangement is due to the formative and changing nature of curricula and requirements for degrees.

The following statements show the state of flux of the present situation in public-health education, and also give the important developments in some of our universities. These quotations are extracts from letters recently received in response to a questionnaire.

University of California:

It is rather difficult to answer your letter concerning public-health work in this university at the present time, owing to the fact that we are just going through what we believe are the final stages in forming a school of public health.

The establishment of this school will enable us to bring together curricula and standardized courses much better than we have been doing, although we have been endeavoring to give a thoroughly rounded course for several years and to turn out students of three or four different types in this field.

The course at present is given in a number of different departments, and our system of departmental majors for the bachelor's degree means that students majoring in any one of these departments which will eventually constitute the school of public health will eventually be grouped as public-health majors.

I may say in explanation that the curricula as outlined have been administered by a committee of the graduate school, pending the establishment of a school of public health. As soon as this school is established, certain minor changes will be made in the curricula, and in addition it is planned to give the degree of doctor of public health instead of the degree of graduate of public health, as at present, and instead of a master's degree of the graduate school (A. M.) the degree of master of science in public health.

FREDERICK P. GAY.

University of Michigan:

These courses, however, I ought to add, are now under radical revision. Indeed, in the announcement soon to replace that which I am sending you separately, the paragraphs given on the inclosed sheet will be included and will show that we are working upon a new plan for the conduct of all the work in public health.

ALFRED H. LLOYD.

Johns Hopkins University:

For the sake of completeness I may say that our registration for the present year is:

Doctors of public health	18
Doctors of science in hygiene	31
Bachelors of science in hygiene	4
Certificates in public health	11

This list does not include any special students, of which this year we have 67.

W. H. HOWELL.

Massachusetts Institute of Technology:

Regarding the period when public-health training was first given to the students in the Institute, I may say that this really had its inception with the coming of Professor Sedgwick to the Institute in 1883. The first graduates under this instruction for the whole period of four years were therefore in the class of 1887, of which Professor Jordan was a member, and which also included two or three other men and women who went into medical or allied work. Special emphasis was given to the public-health side of the work with the establishment of the course in sanitary engineering, the first graduates of which were in the class of 1892. Much emphasis was placed on public-health administration and courses specially pertaining to this field given in the middle of the nineties, and so far as I can recall we turned out our first man, who immediately took a job as health officer, in 1896. Since that time men have been going into this profession from both the course in biology and the course in sanitary engineering regularly every year. The number of men and women entering the courses in biology and sanitary engineering has shown a gradual upward tendency, except that since the war the number of men who have gone into sanitary engineering has been very much smaller than previously. In 1914, 19 men were graduated from this department, and for several years the average was 15. This has now dropped temporarily to a much smaller number, presumably because of the fact that chemical engineering seems to have been the field in which the attractive positions lay, outside the old stand-bys of civil, mechanical, and electrical engineering. With reference to the present tendency in our own department, it is undoubtedly for larger numbers of men to seek the training in biology and public health than previously. If I am correct in my data we now have in the department about 30 men enrolled in the course in biology and public health. I can not speak exactly on this point because we do not come in actual contact with the students until the middle of the second year, and it is not possible to know exactly how many first-year students are aiming toward public-health work. It is a fact, however, that the number is gradually increasing. We shall graduate this year 9 men in biology and public health, and there will be some special students who had nearly all the courses required for a degree in addition. In sanitary engineering I think there will be 8 men.

SAMUEL C. PRESCOTT.

New York University:

The courses given by New York University are chiefly for those who are already in public health.

The 25 days of residence, or the 300 hours of reading, plus 6 days of residence are courses giving a certificate and are approved of by the New York State Council on Public Health.

At the present time, there are about 30 taking the correspondence course and three the doctor of public health course.

WILLIAM H. PARK.

University of Wisconsin:

Since the marked development of your school and the one at Hopkins, with the large number of fellowships available, I have adopted the principle that it would be wrong to urge men to come here when better opportunities are available elsewhere, so in each instance when men have come to me for advice I have urged them to go for public-health work either to Hopkins or Harvard. We have had a half-dozen graduates taking either a master of public health degree or a doctor of public health degree, but none within the last two or three years. We do have a number of young women majoring in bacteriology either in the medical school or in the school of agriculture with a view of doing laboratory work either in public-health laboratories or hospitals. I assume, however, that it is not that type of student that you are interested in.

PAUL F. CLARK.

Detroit College of Medicine and Surgery:

Correspondence with various applicants seems to indicate that there are schools where the doctorate in public health can be secured by any man possessing a baccalaureate degree as a preliminary qualification, upon completion of an amount of professional study considerably below that which we demand.

W. H. MACCRACKEN.

Syracuse and Cornell Universities:

So far as our course for health officers is concerned, there were 23 members, 13 of whom took the course at Ithaca in connection with Cornell University and 10 in connection with Syracuse. The number graduated from the two courses was 22.

We simply give certificates for these graduates, as they do not have a sufficient length of course to take the degree. The college gives a very good course in connection with the medical school, but it does not give them a special certificate for the health work; this is simply included in their regular college course, for which they receive a single college diploma.

F. W. Sears.

Yale University:

So far as actual graduate courses were concerned, we are reasonably well satisfied with the situation, but we believe that a closer contact with the medical school is essential in order to attract the younger graduates in medicine into this field. We have just secured a revision of the curriculum of the medical school which frees the student of nearly a year of the present work. Sixty per cent of the time thus freed will have to be spent on electives, and we have arranged a combined course by which a student electing the public health option in his medical course would spend the summer between his third and fourth medical years in the dispensary to secure the degree of doctor of public health in one year after graduation. This will not go into force until the class of 1926, but the step is, I think, a very important one, not primarily on account of the saving of time, but on account of the opportunity of calling the existence of the public health field to the attention of medical students at an early stage.

C.-E. A. Winslow.

THE STATUS OF STANDARDIZATION.

The amount of discord with reference to courses and degrees in public health offered by different institutions is shown very clearly in the following table, taken from the report of the committee of the American Public Health Association, above referred to.

Table III.

Degree.	Number of schools giving degree.	Time required.
Bachelor of science in hygiene	1	2 years.
Bachelor of science in public health	1	4 weeks.
Certificate	1	7 weeks.
Certificate	1	Indefinite.
Certificate in public health	3	1 year.
Certificate in public health	1	Indefinite.
C. P. H. in industrial hygiene	1	1 year.
C. P. H. nursing	1	1 year.
Certified sanitarian	1	1 year.
Diploma in public health	1	3-6 months.
Diploma in public health	2	1 year.
Diploma in public hygiene	1	1 year.
Diploma in tropical medicine and hygiene	1	1 year.
Doctor of philosophy in public health	2	Indefinite.
Doctor of public health	1	36 hours.
Doctor of public health	1	2-3 years.
Doctor of public health	7	2 years.
Dr. P. H. in industrial hygiene	1	2 years.
Doctor of science in hygiene	1	3 years.
Doctor of science in public health	1	3 years.
Graduate in public health	1	1½-4 years.
Master of arts in public health	1	1 year.
Master of public health	2	1 year.
Master of science in public health	2	1 year.
Master of science in public health	1	1-2 years.

This exhibit makes plain the woeful lack of standardization. Some institutions give not only a certificate in public health, but even a doctorate in public health through correspondence courses and a few weeks' attendance in residence. The tendency, however, is to require a minimum of one year of residence devoted entirely to serious study for a certificate in public health and no less than two years of advanced graduate work for a doctorate in public health.

A good beginning was made in the task of standardizing degrees in public health at a conference called at Yale University early in 1919, at which representatives from certain eastern universities particularly interested in the subject were brought together. Johns Hopkins University was represented by Dr. W. H. Welch; the Massachusetts Institute of Technology by Prof. W. T. Sedgwick; Harvard University by Dr. M. J. Rosenau; New York University by Dr. W. H. Park; and the University of Pennsylvania by Dr. H. F. Smyth; while Yale University was represented by a special committee from the graduate school, including Prof. S. E. Barney, Prof. L. B. Mendel, Prof. L. F. Rettger, Prof. M. C. Winternitz, and Prof. C.-E. A. Winslow. Resolutions unanimously adopted at this conference were published.

Certain definite views have crystallized out of the situation with reference to the standardization of entrance requirements, curricula, and degrees. The best practice may be summarized as follows: Those who wish to enter public health work should have a knowledge of physics, chemistry, and biology of college grade. Following this, it is essential to know normal structure and function—in other words, anatomy and physiology; also abnormal structure and function—that is, pathology and bacteriology. The fundamental preliminary requirements, then, for admission to a satisfactory education for a public health career rest first of all upon a knowledge of the achievements of and an acquaintance with the methods of science. To this must be added training in the fundamental medical sciences which usually occupy the first two years of a medical curriculum. More specifically, these are embryology, histology, anatomy, physiology, biological chemistry, bacteriology, and pathology. With this foundation, a student is prepared to matriculate for a degree which would involve the following minimum conditions:

Bachelor of public health.—One year in residence, including courses in vital statistics, sanitary engineering, epidemiology, public health administration, etc.

Master of public health.—One year of graduate study following the bachelor's degree.

Doctor of philosophy or doctor of science in hygiene.—At least three years of work following the bachelor's degree, including high attainments and special study in a particular field. These degrees, in order to conform with academic usage, should include a major and several minors and also a thesis showing original treatment based upon research of a special problem.

Doctor of public health.—Candidacy to this degree should be limited to those who have a medical degree and should include two years of graduate work following the medical degree. The object of this degree should be either (1) to train men for administrative or teaching positions, or (2) to develop specialists in the various lines of hygiene and sanitation.

While a certain amount of academic uniformity is desirable, especially with reference to requirements for degrees, on the other hand it would be a serious mistake to encourage a fixed system of curricula and degrees that would freeze health education into rigidity. The present status calls for freedom, elasticity, and individuality. The same mistake should not be made in schools of public health that has arisen in schools of medicine. A satisfactory method of training health officers seems to have crystallized out of our short experience, but we should take the attitude that the best methods are still to be discovered.

Experience has shown that training for public-health service divides itself rather sharply into those who wish to fit themselves for administrative positions and those who wish to fit themselves for some specialty, such as laboratory work, sanitary engineering, vital statistics, sanitary chemistry, etc. The above scheme provides for the training of both medical and non-medical men, but in both cases requires the fundamental medical sciences.

THE PRESENT STATUS OF THE STUDENT IN PUBLIC HEALTH.

The number of students attracted to the various schools offering courses in public health is showing slow but steady and wholesome growth. Those familiar with the present state of affairs are quite well aware that the demand for well-trained health officials exceeds the supply. It is further quite evident that the fruits of hygiene and sanitation and the benefits of preventive medicine are not garnered for want of trained leadership.

There is a decided lag between knowledge and accomplishment. In other words, our knowledge has not yet become part of the wisdom of the community. In order to bridge this gap, educational and economic improvements are necessary, sometimes amounting in magnitude to social reformations. The next step in the health program evidently is to provide well-trained administrators who will also be sound teachers, able to guide the people in the art of hygienic living and instruct them in the prevention of infection.

Public-health careers and the education for public health service are not yet sufficiently developed to attract the best men into the field. The present status in this regard, then, is unsatisfactory. All those interested in public health education are straining at the leash in order to improve this phase of the situation. At present progress is slow, for the rewards of the clinician are alluring when contrasted with the meager pay and uncertain tenure of office of the health officer. Until quite recently there were almost no special laboratories devoted primarily to the advancement of the sanitary sciences to attract devotees of pure science in public health problems. It is clear to those who have education for public health service at heart that it is important to attract the best men in the early stages of their careers, and it is a pleasure to see that adequate institutions are being established to supply one feature of this want. The other feature will come more gradually with improvement in health administration and public recognition of its usefulness.

THE STATUS OF THE RELATION TO MEDICAL EDUCATION.

The object of public health work is to improve human efficiency and to prevent disease. Both of these objects make for a longer, a surer, a happier, and a better existence. It is clear that both these objects, namely, better health and less disease, rest in great part upon the medical sciences. To improve health depends upon physiology, and to prevent disease rests upon pathology. In other words, both individual efficiency and private health, as well as community progress and public health, depend to a large extent upon the fundamental medical sciences. These must therefore be the background of education for a public health career. Without them failure and even disaster is invited, for there is apt to be imperfect perspective and confusion of relative values. The present status of public health education in this country has shown two directions: (1) To organize schools of public health apart from medical schools; and (2) to organize schools of public health in direct association with medical schools. In my judgment, the latter arrangement is sound and logical and will best serve the purpose. This is the plan at Harvard. I am free to predict that it will be the future and final development. The effect of two schools, one of public health and one of medicine, closely coordinated must be mutually favorable. The public health school obviously profits by much that the medical school has to offer and is in a strategic position to attract students during their formative stage into the field of hygiene and sanitation. On the other hand, the medical school will inevitably profit by a close correlation with a school of public health in various ways, directly and indirectly. The influence both upon the faculty and the students in gaining the viewpoint of prevention, as well as of cure, will be impressive and will inevitably broaden the practicing physician and make him a more useful member of the community.

Whether or not schools of public health develop alongside of medical schools, men and women will continue for a long time to enter the field of public health from various educational directions. Many, as heretofore, will have a medical education with no special training in public health: others will come in through engineering, bacteriology, or chemistry, etc.

This is not the proper place to consider the teaching of preventive medicine and hygiene in medical schools, and I would not open this subject had it not been mentioned in the agenda. A school of public health, however closely associated with a medical school, only accentuates the need of adequate teaching in hygiene in the medical curriculum. Every student working for a medical degree should get not only the facts but also the viewpoint of prevention. In no other way can he do his full duty to both the patient and the public. The close association should inspire both the medical faculty and the medical student with the ideals of prevention and serve, furthermore, to reveal the opportunities and soul satisfaction derived in the service of Hygeia.

No school of public health, however well organized and conducted, can hope to turn out a finished product. In other words, a man is not necessarily a competent administrator or a successful sanitarian just because he has been trained in a school of public health. We find the same situation in other professional schools. Just because a man receives a medical degree does not mean he is a good doctor. A graduate of a law school has only the foundation to practice law. We would not place the responsibility of designing and building a large bridge in the hands of the honor man who has just received his degree from the best engineering school in the world. In addition to the fundamental education which is given at school, the graduate then needs experience, perspective, vision, and maturity. In addition, he must have character and qualities of leadership. Many of these traits can not be originated in school, although aptitudes can be developed, latent characteristics made dominant, and moral fiber fortified. The spirit of the training should be to give adequate instruction in the fundamental sciences on which successful health administration rests, with some insight into the best types of Federal, State, and local practice.

THE PRESENT STATUS IN ENGLAND.

It is interesting to compare the present status in our own country with that in England. I commissioned one of my students (Miss Caroline Stevens) to make a survey of public health education in England, and her report, just at hand, clearly gives the situation there.

THE PRESENT STATUS OF PUBLIC HEALTH EDUCATION IN ENGLAND.[7]

By Caroline Stevens.

Public health education in England is organized at present to reach four types of workers. Each group will be considered separately.

I. *Doctors of hygiene or of public health*—"*D. P. H.*"—Courses leading to this degree are open only to men and women holding a medical degree from a recognized medical school. The shortest length of time in which the whole course may be taken is nine months, generally divided as follows:

Six months' laboratory work.

Three months' chemical.

Three months' bacteriological.

Three months in a fever hospital for administrative purposes.

Six months' practical work with a medical officer of health, or reduced to three months if attending a course of lectures by recognized teachers.

An examination must be passed at the conclusion of these courses, "which extends over not less than four days, one of which shall have been devoted to practical work in a laboratory and one to practical examination in and reporting on subjects which fall within the duties of a medical officer." In October these rules were under consideration and it was probable that in the near future they would be altered slightly in an effort to increase the standard.

This course is obtainable in some 22 universities well distributed throughout the British Isles and at the Royal Institute of Public Health in London. Some of the more important schools are Durham, Leeds, Liverpool, Birmingham, Edinburgh, Manchester, Bristol, Sheffield, Cambridge, Kings College of London, University College of London, Aberdeen, Glasgow, which gives a B. Sc. and D. Sc., but not yet a D. P. H., and Wales.

The courses given at the University of Cambridge show that the English training is similar to the American, although probably less theoretical and more practical. The following subjects are either treated differently or not at all in the American schools:

Under meteorology and climate—Meteorological charts and reports.

Under elementary physics—Physical properties of gases and liquids, laws of pressure in liquids, gases dissolved in liquids, specific heat and latent heat, dew point, hygrometry.

Under bacteriology—Methods of bacteriological examination of animals dead of bacterial diseases.

Under practical sanitary administration—Houses in course of construction, drainage, testing drains (smoke test, water test), defects, reconstructions. Office books and records kept.

During the three months' work in a fever hospital the subjects covered are as follows:[8]

Site, situation, general arrangements of buildings, number of beds, recommendations of late L. G. B.

General supervision—Work of assistant medical officers, stewards, dispenser, relation to ambulance station, control of nursing staff.

General public—Admission of visitors, control of public in hospital grounds, exclusion from wards, disinfection on entering and leaving grounds, warning notices, reinfection.

Hospital committee—Relation to medical superintendent, meetings, joint hospital boards, admission of cases from other districts, M. O. H. relation to hospital.

Laboratory—stores—laundry.

The following diseases are particularly studied while at the fever hospital:

Scarlet fever—Admission of cases, allocation to suitable wards as regards age, sex, and severity of disease; acute wards, septic wards, plans of large and small wards, doubtful cases, differential diagnosis, transfer convalescents, discharge of patients, methods of disinfection, warning to patients; brief résumé of anomalous types and points in differential diagnosis.

---

[7] In October, 1921, I made a survey of public health education in England, at the request of Dr. M. J. Rosenau. In order to obtain my information I interviewed Sir George Newman, minister of health; Sir Arthur Newsholme; and Dr. MacDonnel, a recent student in public health, and I visited 5 educational institutions in London. I also gathered information through correspondence with 14 universities in England, Scotland, and Wales, and with the General Medical Council. Although the only means of ascertaining the more practical details of the courses is by participation in the public health course of a university, a general idea of the British plan of health education was obtained.—C. S.

[8] Taken from the report of the University of Manchester.

Diphtheria—Admission of cases, etc.; general routine in wards; clinical and bacteriological diagnosis; methods of giving antitoxin—subcutaneous, intramuscular, and intravenous. Schick reaction; importance and use. Intubation and tracheotomy. Discharge of patients.

Enteric fever—Admission, etc.; general routine in wards, clinical and bacteriological diagnosis, discharge of patients.

The following special problems are studied:

"Barrier" cases—When needed; routine, essentials for success.

Cross infection—Different ways in which it may occur; how to deal with the patient, the other patients, and the wards.

"Carriers"—Diseases, virulent or not, segregation, treatment.

Disinfection—Of patients, of staff, or wards, of clothing, bedding, etc.

As to vital statistics, only the simpler calculations are required, such as methods of estimating population, death, birth, and marriage rates; mortality as affected by age, sex, and occupation; case mortality; life tables; the use of logarithms, the slide rule, and the arithometer.

Three to six months is spent in working directly under a medical officer of health who usually arranges a course of instruction in outdoor and office sanitary work.

The following are examples of textbooks studied and consulted:[a]

Rosenau's Preventive Medicine and Hygiene.
Notter and Firth's Practical Hygiene.
Newsholme and Kerr's School Hygiene.
Kerr's Infectious Diseases.
Manson's Tropical Diseases.
Cobbett's Causes of Tuberculosis.
Rambousek's Industrial Poisoning; translated by Legge.
Herrind Shaw's Domestic Sanitation and Plumbing.
Edelmann's Meat Hygiene; translated by Mohler and Eichhorn.
Public Health (Scotland) Act; edited by McDougall and Murray.
Robertson and Porter's Sanitary Law and Practice.
Bell's Sale of Food and Drugs Act.
Muir and Ritchie's Bacteriology.
Sommerville's Practical Sanitary Science.
Turneure and Russell's Public Water Supplies.
Lane-Claypon's Milk and Its Hygienic Relations.
Moore's Descriptive Meteorology.

The method of examination used by the University of Sheffield is exemplary.

PART I.

1. A three hours' written examination on chemistry as applied to public health.
2. A four hours' practical examination on chemistry as applied to public health.
3. A four hours' practical examination on practical pathology and bacteriology as applied to public health.
4. A three hours' written paper on bacteriology.
5. An oral examination on the above subjects.

PART II.

1. Two written examinations in public health.
2. Sanitary reporting.
3. Oral examination on the above subjects.

---

[a] Taken from the catalogue of the University of Aberdeen.

II. *Nonmedical but professional officers* (midwives, sanitary inspectors, and health visitors).

There are three or four institutes in London providing courses for this class of worker. Only what corresponds to our elementary-school education and some practical experience in the subject to be studied is required of candidates.

(*a*) The Royal Sanitary Institute in London has done a great deal to standardize health work throughout the United Kingdom by giving courses and maintaining carefully supervised examinations for a certificate in many centers in England, Scotland, Ireland, India, Canada, Hongkong, South China, South Africa, Australia, Tasmania, New Zealand, and the British West Indies. The places for examination vary somewhat from year to year. The Institute maintains a lecture hall, a library, and an exceedingly interesting museum in London and publishes a journal. It also does considerable parliamentary work and holds public meetings, lectures, and exhibitions. Courses and examinations are held according to the following plan:

(1) Sanitary science as applied to buildings and public works for sanitary officers or inspectors.

(2) School hygiene, including elementary physiology, for school-teachers.

(3) Course leading to a certification of qualification for post of smoke inspector.

(4) Courses fulfilling the requirements of the board of education for women health visitors and school nurses.

(5) Courses and examination for maternity and child welfare workers. This course requires a wider experience and more developed knowledge of subjects pertaining to child welfare than for the health visitor.

(6) Course for inspector of meat and other foods.

(7) Course for inspector of nuisances.

(*b*) National Health Society.—This society, unlike the Royal Sanitary Institute, has only one institution, and that is in London. It provides the following training courses:

(1) For health visitors and infant welfare workers.
    (*a*) A full course of two years for inexperienced students.
    (*b*) A shortened course of one year for hospital nurse graduates, health visitors who have spent not less than three years in full-time employment, students who have obtained a university degree or its equivalent.

(2) For sanitary inspectors.

In these courses, as in those for the D. P. H., there is a great deal of practical work. The health visitor or child welfare worker if taking course (*a*) must spend at least four months at an infant and child welfare center the first year, and practically all her time the second year in a poor-law infirmary or infants' nursing home and ophthalmic hospital and infant welfare center.

(*c*) Midwives.—Throughout the country there are institutions, approved by the central board, where midwives and nurses may obtain training in midwifery. A certificate approved by said board is granted to those satisfactorily completing the course, which lasts six months (or less for nurses). A graduate must have brought into the world no less than 20 babies.

III. *School-teachers.*—There are about 80 "training colleges for teachers" (comparable to our normal schools) in Great Britain, where secondary-school teachers obtain their training. One of the several courses which teachers are required to pass in is hygiene, and covers the following subjects:

Section 1. Food; fresh air; exercise; warmth; rest and sleep; cleanliness.

Section 2. The senses and their training.

Section 3. Training the child in the practice of hygiene.

Section 4. Common ailments in school children.

Section 5. Special groups of school children, statutory power and duties relating to abnormal children; physically defective, dull, and backward children, etc.

Section 6. Welfare of infants and young children, principal causes of infant mortality, etc.

Section 7. The work of the school medical service.

Section 8. The school building and its surroundings.

A so-called "temperance" syllabus which outlines for the teacher the misuse and abuse of foods and of alcohol and is a guide for her in teaching the "hygiene of food and drink" has been published by the board of education and extensively used by teachers in the schools.

IV. *Voluntary workers.*—There are many "polytechnic institutes" and similar technical and scientific schools throughout Great Britain providing training courses for high-school graduates who do not wish to become as highly trained as the ordinary sanitary inspector, but who wish to take some of the courses for the health visitor or infant welfare worker, etc. The London Battersea Polytechnic Institute gives, in addition to the above-mentioned courses, an advanced hygiene course for secondary-school teachers who wish to make more of a specialty of hygiene than is possible in the board of education training colleges. Often high-school graduates who are still too young to enter a nurses' training school take a preparatory course here. Although intended for nonprofessional as well as professional men and women the school maintains a high standard and has extraordinarily practical courses for all sorts of health inspectors as well as for general public-health workers. It helps to meet the great demand of public-health officers for trained assistants. The Royal Sanitary Institute, mentioned above, also trains voluntary workers.

CONCLUSION.

From the above analysis one immediately sees that many training courses are provided for the voluntary worker, the professional worker who has not a medical degree, and for the highly specialized doctor, and that a great deal of emphasis is put on the practical part of the training.

The administration of public-health activities is so completely organized that the demand for such workers is extremely great. London itself is divided into 28 boroughs, plus the city of London, each with its representative council, who employ as specialists an architect, a lawyer, a financial adviser, etc., and a sanitary officer. The sanitary officer is responsible for all the health work of the district, and is the executive having under him clerks, a sanitary inspector, a health visitor, and possibly a nurse. The child welfare and other clinics are all under his direction. He is responsible through the council to the people. It is under such an officer that each D. P. H. student must spend from three to six months of his time. This sanitary officer must have a D. P. H., and also practically all school doctors are required by the ministry of health to have the degree.

The schools that give a D. P. H. degree (comparable to our C. P. H.) require, I believe, a higher standard than ours, because they only take candidates who already have a medical degree. The nonmedical students are trained in schools of their own. The fact that the ministry of health requires practically all school doctors and sanitary officers to have this degree makes the training very desirable. It differs from ours because much more time is spent doing the actual work under trained supervision. Vital statistics are only touched, and in the laboratory much more time is spent on the practical tests and analyses than on theory. Also, almost every large university has a well-established department of public health, thus making the training easily available.

THE 1922 CONGRESS ON MEDICAL EDUCATION, MEDICAL LICENSURE, PUBLIC HEALTH AND HOSPITALS AND ITS CONCLUSIONS REGARDING THE EDUCATION OF SANITARIANS.

Dr. Frederick R. Green, *American Medical Association.*

My subject as assigned by the chairman is a discussion of the points that were brought out at the Conference on Medical Education, Hospitals and Public Health of the American Medical Association at Chicago last week. I understand that there was one paper presented on the second day of the conference that slightly touched on this question. I asked the official reporter to give me a synopsis of it by Monday morning before I left, but I did not receive it. With that exception there was no consideration given that question. We had the most successful conference that has been held under the general supervision of the American Medical Association, the Association of the State Examining Boards, the Association of State Medical Colleges, and this year, for the first time, the Hospital Conference. The five-day conference was practically filled with every subject that could be imagined in the field of medical education. But the question of the education of health officers was not considered as far as I know.

This being the case, with the permission of the chairman and the Surgeon General, I would like to devote the few minutes assigned me to discussing another question which has been in my mind for many years, concerning not only the education of health officers but also the education of physicians.

John Fiske in the introduction to his History of the Discovery of America stated that in the hundred years between 1450 and 1550 the knowledge of the civilized world regarding the Western Continent increased so rapidly as to make it impossible for one or even two generations to assimilate the knowledge which had been gained, or to estimate the benefit of these discoveries on civilization. The same statement may be applied to the last 50 years in medicine. Our knowledge has increased so rapidly and we have gained such minute medical knowledge that the present generation fails to grasp or realize the effect that it is going to have on civilization and society in the future. Therefore it is not strange that our methods of medical education have very largely remained the same in principle, with a very large increase in detail, as they were 50 years ago.

The admirable sketch of the history of the development of our knowledge of public health given by Doctor Freeman and the résumé of the present status of public-health education given by Professor Rosenau make it necessary to allude to the details of the history of the last 50 years, familiar to all of you. I am sure that all of us got some additional facts and some additional light from the two papers which have preceded. There is one striking feature, however, that it seems to me has not yet been sufficiently dwelt upon. The fact is that while our medical education has increased enormously as far as detail is concerned, it remains largely the same as far as principle is concerned in that to-day as yesterday instruction given to medical students is individualistic; that is, it bears entirely on the relation of the individual physician to the individual patient and has to do with the examination and treatment of patients as individuals. Prior to the middle of the last century the only responsibility which a physician had was his individual responsibility as a practitioner to an individual patient. As Sir George Newman said, prior to 1850 the only public-health functions that any medical man had were the enforcement of the police laws for the prevention of the mingling of the infected and the uninfected. The relation of the physician to the community was entirely individual. He had no conception whatever of any social duties or any social relations. No act of his in any way could affect society, because he had no knowledge of his relation to the community of which he was a part, nor of the social facts of disease nor of any duty to society en masse.

There are two distinct methods of approach to any problem, just as there are two distinct kinds of minds. There is the analytical mind, which analyzes all questions and devotes itself to the study of minute and concrete details, and the synthetical mind, which from the mass of data accumulated formulates the general principles which will be a guide for future action. The work of the medical profession in the last 50 years has been along analytical rather than synthetical lines. We have come to the point where we have an enormous mass of data which has not been worked out. Until this is done, the relation of the medical profession to the public, to the community, or to the State can not be definitely determined.

As Doctor Rosenau says, the education of the medical man and the education of the public-health officer necessarily run along parallel lines. There would seem to be only three ways in which public-health officers could be educated. First, by regarding the public-health course as a special course to be taken as an addition or a supplementary course to a general medical course. Second, by regarding the first two years as a basic course, for either physicians' or public-health officers; by having all men who intended to do medical work or public-health work take the same two years of a basic course and then each one switch off into the particular line he was going to follow, the public-health officer taking a special course in his last two years, while the medical man takes up scientific medicine and diseases. Third, to regard them as independent and separate lines of work and give each class a separate training. The third, so far as I know, has never been suggested. The first two have often been discussed.

Whichever of these two courses is followed, we know what the public-health officer of the future is to be as far as his basic training is concerned. In addition he must have some training in the relation of the physician either as an individual practitioner or as a health officer to the community or to society en masse. The medical student to-day gets very little systematic instruction in his social relations to his fellow practitioners, to the public, or to the State. He has consequently very hazy ideas regarding social and economic questions. I have been occupied very largely for the past 18 years answering letters and in offering advice to medical men and to medical organizations in regard to the solution of these problems, but rather in the field of applied or social medicine. It is perfectly astonishing to realize how very little thought physicians have given to such questions as the legal regulation of the practice of medicine, the relation of the physician to the State, health insurance, social and community medicine, the relation of modern medicine to industrialism. They have received hardly any instruction whatever in medical courses along these lines. The bulk of the time of the medical student is given almost exclusively to the study of medicine as applied to the individual patient without any instruction of the duties of the physician to society or the mass. The average physician is so little informed as to his personal relations that he does not realize that it is not the duty of the State by forceful law to protect him from competition. He thinks that medical practice acts are passed to confer certain rights on him; therefore he regards the sectarian as an invader and as a rival to be suppressed by law.

I simply want to suggest that, in the reorganization of the medical course, of the medical curriculum, coming in the near future through choice or necessity, some place should be provided for some such course of instruction. It is my view that the freshman class should be given at least one hour a week throughout the course on the history of medicine, so that the student will know something about the growth of his profession. During the second year, at least one hour a week should be given to medical sociology and the application of medicine and our knowledge of prevention of disease to social problems and social conditions. During the third year, one hour a week should be given to the economics of medicine. We are sending out to-day the most capable and highly trained medical graduates, so far as scientific training is concerned, we have ever been turning out. But we are not teaching them enough of the practical aspect of the profession. The result is that many thoroughly capable men fall down on the business side. During the fourth year, one hour a week should be given to instruction, first, in the legal side of medicine—the legal relations of the physician to society, to his individual patient, to his own professional associates—and then additional instruction should be given in the ethical side of medicine. Also instruction should be given regarding medical organization—the necessity for it, the history of medical organization, and the policies of our organizations throughout the country.

If we can do this, and in this short time give the medical student of to-day, in addition to the highly scientific and the highly effective training that he is getting in the scientific phase of medicine, a sociological education, he will have a better conception of his duties toward those suffering from specific disease, and understand something in regard to his social relations to the community. Also, through this instruction, we will very greatly relieve much of the unrest which is to-day caused by these problems. Whether he engages in public-health work or in the private practice of medicine, the physician of the future will need this knowledge.

II. NEWER ASPECTS OF PUBLIC HEALTH AND THEIR IMPORTANCE IN TRAINING OF SANITARIANS.

MENTAL HYGIENE.

Dr. WILLIAM A. WHITE, *Superintendent St. Elizabeths Hospital.*

Those of us who are interested in mental hygiene are inclined to think that to leave out of a course of instruction in public health the mental hygiene aspects would be a good deal like leaving Hamlet out of "Hamlet."

We have been engaged in a propaganda for a good many years to get psychiatry introduced in the medical curriculum, and we are succeeding fairly well in that respect. It is equally important to get mental hygiene introduced into the courses in public health which are now growing up in the large universities of the United States. I may make this point briefly by asking this question: What particular use is the healthy body, which the sanitarian is aiming to insure, if it does not have a reasonably healthy mind to guide and direct it? The body is only an instrument to bring to pass the ideals, the ideas, the aims and objects which our minds formulate, and unless our minds can formulate reasonable aims and objects, our healthy bodies are not very much good. I know many idiots who have perfectly healthy bodies, and many individuals with very wonderful minds who have very delicate bodies.

Every life, as Spencer defines it, is a continuous adjustment to its outer and inner relations. It would seem that in the past the work of the sanitarian has been confined very largely to what might be called outer relations, and that the time is now coming when the inner relations might be inquired into. I remember when I was doing quantitative analysis in chemistry the first job I had was to find out whether the graduations on the burette for liquid measurement were correct, and if not then to make the necessary corrections.

We are very much in the same position with reference to the human mind. The human mind must know something or other about the way it is going to use this body of ours. We must be able to calibrate it. We can not get very far when the graduations are inaccurate and we do not know how to correct them.

With that rather platitudinous introduction to an audience of this caliber, may I say that the program of mental hygiene has a host of accomplishments already back of it to which it can point, which serve as sufficient arguments for its claim to be included in the course of instruction in public health. Let me cite just a few of them. Take, for example, in the institutions for the care of the insane. A great many of these institutions throughout the country are now conducting out-patient departments—dispensary departments—where patients may come for medical advice and where they keep track of patients on parole. The out-patient department of St. Elizabeths Hospital in something less than two years has succeeded in increasing the number of patients on parole 300 per cent and in increasing the number of days on parole approximately 600 per cent. That is a perfectly concrete result of actual mental hygiene work, and that, along with many other facts, indicates that mental diseases, just like other diseases, show perfectly evident signs of our ability to bring them within the operation of the principles of preventive medicine, with a very large degree of success.

I call attention to the activities of the juvenile delinquency courts and to the work that has been done, such as Healy did and is now doing in Chicago and Boston. I call attention to similar work which is being done in what might be called industrial psychiatry, and the work of physicians in the large industrial organizations—the seeking out of troubles, the causes of the maladjustment of individual workmen, finding out why people get discharged, and why they leave their jobs, making an effort to fit the job to the man, the man to the job. This makes for efficiency, and is a welfare movement on behalf of the man, too. It is largely of a psychiatric nature, and those who are engaged in it are frequently psychiatrists. They are the men who have the work of adjustment to perform, the work of guidance, which comes essentially within the mental hygiene work of the future. All this is exceedingly important. There is also the work of occupational therapy, which has been introduced so largely into many of our hospitals since the war and which produces its results largely through its mental effects.

I will mention a few other examples in which the fundamental problems involved are mental problems. For example, there is the problem of drug addiction—a very important social problem of today. There is no question but that this problem will never be adequately handled until the psychological factors which enter into it are understood. The same is true with regard to the problem of intoxication. Feeble-mindedness is obviously a problem which belongs to mental medicine, to preventive medicine. The problem of the criminal is also 50 per cent psychological and of first importance socially, as the developments of recent years have clearly indicated. The problem of the unusual child; the problem of morale, which was developed so largely during the war; the problem of industrial fatigue—all of them have large psychological components. The solution of them all is of the greatest social significance.

There are a number of other problems which are of psychological importance, which would come within the purview of a course in mental hygiene, largely conceived. Take the problem of social unrest. The British commission which investigated the problem of social unrest in 1917 showed very clearly that this problem was essentially a psychological problem and that it could not be attacked without attention to the psychological factors. For instance, a group of defectives, a group of idiots or psychopaths, is a focus of serious danger to the community. It is perfectly evident that wherever you find a group of defectives or psychopaths you find a potential focus of unrest, of social disease, of filth, which, if you can read the signs accurately, is just as dangerous, if not more dangerous, to the social organization than physical disease. A great deal of social unrest is therefore dependent upon various degrees of psychopathy and feeble-mindedness. There is a social unrest which is legitimate, and which is the manifest sign of progress and development; but there is a destructive unrest which is exceedingly dangerous, and it is of exceeding importance that something should be known about it. It is important that we know how beliefs spread by contagion, and the methods of attacking them. We know in psychiatry that we can not attack delusions by reason, nor can we attack these social manifestations in any such way.

The turnover in industrial plants, the enormous amount of change in our big industrial centers, is a matter which is also largely psychological, and has its mental hygiene significance. It is often dependent upon mental defect or aberration. A study of the causes that lie behind these great turnovers will develop, I am sure, a program which will enable us to use some types of defective or psychopathic individuals much more advantageously in industrial work.

The studies in connection with matters of social unrest, fatigue, the adaption of the human machine to the machine of steel and iron, which are taking place in our industrial centers, are all matters of the utmost significance for the general mental health of the community, and for social welfare, and I think they come within a program of mental hygiene when that program is widely conceived.

They are also all matters which the psychiatrist and social worker are at present ready, more or less, to tackle, because of their special training. The psychiatrist and the psychiatric social worker are engaged all the time in solving problems of maladjustment and individual unrest. Their education makes them look at those problems from the individual's point of view. Now if the sanitarian has been engaged in looking at things from the outside and is to turn his attention to the inside, the development is going to be beyond matters concerning only personal sanitation and personal hygiene, and it will be essential that public health courses retain some orientation to these problems of mental hygiene, and that the student taking up a course in public health should have some instruction along these general lines, or else at least that he should have an opportunity in his postgraduate work to specialize in these directions

CHILD HYGIENE.

Dr. RICHARD M. SMITH, *Instructor in Pediatrics, Harvard University Medical School.*

In the first place may I say that it is impossible to consider the subject of child hygiene apart from the whole public-health field, because anything which has to do with the health of the community is shown directly in the improvement of the health of the child. The child is the most sensitive index of the work in the social field.

There are several things which seem to me especially important if we are interested in child hygiene. It is important that we separate instruction in child hygiene which is given to undergraduates from that which is given to older students, or students who are specializing in public health. The undergraduate is not ready, has not a sufficient background to comprehend most of the problems which concern the administration of child health in the community. With the undergraduate we shall have to confine ourselves mostly to insuring that he has sufficient instruction in the care and understanding of the well child. We find that very much of the instruction in pediatrics in most medical schools is concerned with diagnoses of the children ill with diseases and that relatively little time is given to the consideration of the well child. When the physician is confronted with a series of questions which the anxious mother asks him concerning her well baby or child, he is unqualified to give an answer. Few medical students who go out from our universities go ready to answer questions with regard to normal infants or children.

The development of the child hygiene movement has gone hand in hand with a definite encroachment on the field of the private physician in private practice. If a man goes out from the medical school into practice feeling that the child hygiene movement is taking away from him his legitimate field of private practice, he will be antagonistic to the development of the child hygiene movement. We must see to it that he goes out into the community feeling that this is a definite part of public-health work to which he must make his contribution—that he must be friendly to the advancement of child hygiene and not hostile.

We should see to it that the undergraduate has some slight insight into the organization of public-health work in child hygiene and knows something of the work that private organizations are doing in that line. If he wishes to specialize, he should have at least an opportunity presented to him to do so.

When we come to discuss the instruction of the person who is to make public-health work his career, we come into a very much more complicated and broader field. If any man is going into this course, whether or not he has had a medical-school training, it is essential that he have instruction in certain fundamental medical sciences. He must be able in the field of obstetrics to know whether patients are given proper obstetrical care. He must have a knowledge of the diseases of the new born. These are connected with a community problem with which he must deal—the problem of infant feeding, inadequate nutrition, as it affects children. There is constantly growing a popular agitation in the matter of nutrition, a good many features of which are not founded on very sound scientific facts. The man who is going into public-health work must be able to judge between the good and the bad in nutrition work. He must know the standards of normal development in infants and children; he must be able to decide whether the standards of growth, weight, etc., are proper standards. He must be familiar with the care of the normal child, the thing which I mentioned with reference to the undergraduate. He must know what is the proper food, the proper care, for the normal infant and child. Then he must know also this thing that Doctor White has been speaking about, which is particularly important with reference to the child—he must understand, or at least have some understanding, of the question of mental hygiene. I think there is probably no field of mental hygiene as important as the mental hygiene of childhood. We realize that most of our habits are formed in the early period of life, and upon that period we must place the emphasis if we are going to accomplish the greatest results. He must be familiar with some of the more modern phases of normal development. He must understand the importance of the question of bodily mechanics—the posture, etc.—must direct and guide the work which is done in the community in that connection, must understand the importance of the teeth and their close relation to the problem of nutrition. He must also have a very thorough understanding of infectious diseases, particularly the so-called contagious diseases, not necessarily with particular reference to the treatment, but he must be able to make diagnoses. He must be able to apply the principles of prevention, and this must include recent modern knowledge of heart disease, which we no longer consider a degenerative disease, but which may be treated and prevented.

With this fundamental background, the man who is going into child hygiene work must also receive instruction in the actual operation of child hygiene in the community. This will include instruction regarding the governmental agencies which are demonstrating the work. He must be able to see these agencies in operation and must be able to form his opinion of the value of the different operations. He must become familiar with the private organizations which are working in the community for the children. He must be able to understand the value of prenatal clinics. He must be able to organize and run them and infant clinics and clinics for children of pre-school age. He must certainly have some knowledge of the personnel necessary for running these clinics—we are beginning to feel we must modify the training of field workers in many of these branches. He must be able to organize and conduct faulty posture and nutrition classes, and give dental instruction in the community. All these things which have to do with the actual application of the knowledge which he has received are necessary in order that they may be applied to the community as a whole rather than to the individual.

Then he must be familiar with the problems of school hygiene and school sanitation and the more recent development of health education for children. This is probably the field which has been given the most consideration in the past, but there is still very much that can be done. He must, of course, be familiar with the broader aspects of health problems in the community. I shall only mention this, because it will be discussed later. He must know the social relationships of medicine. There is no field of public health which shows more intimately the connection of the infant group and the general development. The infant is the most sensitive index of the status of the development of the community. He must have some instruction with reference to the feeble-minded and the delinquent. He must have some comprehension of the preparation of the child for industry, which would include an understanding of the occupations which are undesirable and of the occupations which are permissible, and the age limits which are permissible. In addition there are a number of closely allied subjects with which he should certainly be familiar and with which he should be able to exercise a considerable amount of control—the question of illegitimacy, the licensing of midwives, the care of children in institutions, the medical supervision of children in foster homes, the day nurseries, which are now becoming closely associated with the health movement, the lay organizations in the community which are attempting to teach health. All those organizations which are engaged in giving information with reference to health, the man who is interested in child hygiene must know about and he must be able to use. He must know something about the juvenile courts.

The man who is going into child hygiene work or who is to be instructed in it must have a very fundamental knowledge of medical sciences with reference to the diseases of children, and must have knowledge of the application of that knowledge to the community.

ECONOMIC AND SOCIOLOGICAL ASPECTS OF PUBLIC HEALTH.

LEE K. FRANKEL, *Third Vice President, Metropolitan Life Insurance Co.*

Thirteen years have gone by since Prof. Irving Fisher, as a member of the National Conservation Commission, presented his report on National Vitality. The report was both a statement and a prophecy. As a statement it indicated the conditions existing in the United States with respect to health and disease. He pointed out, on the basis of certain data, that the average expectation of life in this country was about 45 years. He estimated that approximately 3,000,000 people were seriously ill in the United States all the time and that of these 500,000 probably had tuberculosis. The economic data were equally interesting. Professor Fisher assumed on the basis of average earnings of $700 per annum that each life sacrificed by preventable disease was worth $1,700. He made the further assumption that 42.3 per cent of existing illnesses are preventable. The economic gain which would result from the prevention of such diseases would exceed one billion dollars.

Along the line of prophecy Professor Fisher predicted that the span of human life could be lengthened from 45 to 60 years, or, approximately, an increase of 15 years. This would mean a reduction in the death rate of 25 per cent. Doctor Fisher pointed out the causes of death which occasioned high mortality. It was his impression that 60 per cent of infantile diarrhea and enteritis could be prevented. Pneumonia could be prevented to the extent of 45 per cent; meningitis by at least 70 per cent; typhoid fever by 85 per cent; tuberculosis of the lungs by 75 per cent. Similarly deaths from violence could be reduced 35 per cent. These six causes of death alone if reduced in the amounts given would lengthen life by nearly eight years. To bring this about four specific conditions, among others, are needed—pure milk, pure water, pure air, and protection from accidents.

To what extent has the experience of recent years proved the correctness of the assumption made by Professor Fisher 13 years ago? Will recent mortality data bear out these statements that human life can be extended? Nothing is clearer in recent statistical data than that life is being lengthened year by year, largely through the reduction in the causes of death referred to in the report on national vitality. There has been an almost constant downward tendency in mortality. Between 1911 and 1920, for ages 1 to 74, there has been a decline of 6.9 per cent for all causes of death in the United States registration area. For the same ages and over the same period there has been a decline of 27.9 per cent in deaths from tuberculosis, 10.5 per cent from children's diseases, 12.8 per cent from chronic nephritis, 16.4 per cent from accidents, 63.1 per cent from typhoid fever. The experience of the Metropolitan Life Insurance Co. for the same ages and period shows a decline of 38.6 per cent for tuberculosis; 22.6 per cent for diseases of children, 17.5 per cent for diseases of the heart, 25.5 per cent for chronic nephritis, 23 per cent for accidents, 70.6 per cent for typhoid fever.

Facts on the expectation of life of wage earners insured in the Metropolitan Life Insurance Co. will be of interest in this connection. Comparing the life expectancy at age 10 in the two calendar years 1911–1912 combined, with the figures for 1919–1920, it was found that the after life-span of white males was increased from 45.6 to 49.5 years. For white females the expectation of life increased from 50.7 to 52.1 years. For colored males and females it rose from 41.3 to 43.8 years.

These data are so well known to sanitarians to-day that they are hardly worth extended comment. No one doubts that the human life can be extended. No one doubts that if the preventable diseases are eradicated, Professor Fisher's prediction of an extension of 15 years to the average human life would be more than fulfilled. For certain diseases we have already reached a low point in the death rate. The measures for the eradication of these diseases are well known and the application of these measures is simple and routine.

The real problem which confronts this conference, therefore, is not that of the prevention of so-called preventable diseases. That such prevention is possible is almost axiomatic. It is true there are certain infectious and contagious diseases about which comparatively little is still understood, notwithstanding the fact that we have known of them for centuries and that these diseases are constantly appearing in our midst. The common ailments such as measles, scarlet fever, whooping cough, and influenza are, in a sense, an unknown field of exploration about which as yet we have known very little. They take their toll of deaths annually, and without knowledge of their cause and origin we have no effective methods of control. It may, however, be safely assumed that these, too, will shortly come to be diseases as readily preventable as smallpox and typhoid fever, yellow fever and cholera. Their prevention and eradication will become the routine task of the health officer and the sanitarian. When their incidence and recurrence has been reduced—and there is every indication that they can be reduced—human life will be materially extended.

There is, however, another group of diseases which requires attention if prolongation of human life is to be accomplished to an even greater extent than it has been in the past. Some of these may be transmissible in the sense that they are of bacterial origin. Others are either the cause or result of certain social or economic influences which still prevail in practically all communities. I refer to the diseases of old age and middle life, the so-called "degenerative diseases," many of which are now being traced back to illnesses which occurred in childhood or early adult life. Others are due to conditions existing in industry, to the rapid rate at which life must be led in large cities, to the marked changes which have taken place generally in our industrial development. Others, again, are either caused by or are the result of ignorance of personal hygiene, inadequate nursing, bad medical practice, insufficient and bad housing conditions. Poverty, it is well realized to-day, is largely due to physical breakdown and in its vicious train brings other diseases of malnutrition, overcrowding, and lack of vitality. From the industrial standpoint, we know that there are industrial poisons and that there are conditions existing in factories, mills, mines, and stores which create their own industrial hazards. We are just beginning to learn the effects of overwork and fatigue due to the length of the working day and the intensity of labor. Our conceptions regarding nutrition and diet are rapidly becoming revolutionized. There are indications that malnutrition is found even in the children of the well-to-do. Notwithstanding the intensive campaign which has been carried on in the reduction of infant mortality, hundreds of thousands of babies and of older children still die year by year—the victims of prenatal and hereditary influences. The results of sex excesses transmitted to progeny still play a tremendous rôle and make the development of eugenics exceedingly difficult. We still know comparatively little about the influences of the climatic elements. While definite statistical data are not available, it is apparent that with an increase in unemployment there is a corresponding increase in the sickness rate.

Legislation also plays a part in producing these conditions. Lack of proper safeguards over the sale of narcotics, stimulants, and drugs of one kind or another and inadequate laws for the protection of child life all play their part. There are still other factors, such as the lack of recreation facilities, lack of sleep, lack of opportunities for play and enjoyment, lack of laws forcing ventilation, ignorance of proper methods of cooking, which add to the lengthy category of evil conditions militating against what should be in an enlightened civilization a progressive normal tendency toward greater length of life.

It is important to note here one of the marked differences between this class of disease and the so-called transmissible diseases. With few exceptions, the latter group manifest themselves in epidemic form. They affect not merely isolated individuals but groups of individuals. Their onset is sudden and the effects often spectacular, and as such many of them run their course very rapidly. The other class of diseases are frequently of slow and insidious development. They affect individuals rather than groups. They become known frequently only when they have been well developed and when they have entered the so-called chronic stage. It is for this reason that the problem of control of this class of diseases means an entirely different procedure if deaths from these diseases are to be reduced or prevented. In substance, any deliberate attempt on a comprehensive scale to lengthen life by the reduction of what for want of a better term I must call the nontransmissible diseases will require the elaboration of a technique which as yet has been developed to a comparatively slight extent, but which, if results are to be obtained, must be universal in its application.

I have stated above that many of these diseases are discovered only when they have reached the chronic stage. In fact, many of them are found only when the possibilities of cure have disappeared and the patients, after long series of suffering and disability, eventually die. We shall accomplish nothing with this class of diseases until we learn, as a common and general practice, how to discover these diseases at their very inception and when they are still amenable to treatment. We must incorporate in our health procedure the business principle of periodic inventory of stock and machinery. Flywheels, boilers, engines are constantly being watched and examined to ascertain whether they are in good running order, so that accidents and shutdowns due to impairment may be avoided. No sensible automobile owner to-day runs his car continually without overhauling. For his own safety he sees to it that the bearings and cylinders, the pumps and the gears, are gone over by competent machinists to see that they are in good condition. This practice is almost universal, and where it is not applied breakdowns and accidents occur. The same principle must be applied in the same universal manner to our human machinery.

No further evidence is needed to-day to prove the need of such periodic physical examinations. The draft examination during the war indicated in an alarming and startling fashion the large number of young men of working age suffering from some type or other of physical impairment. The same results could be shown in a number of industries which realized the need and value of such periodic examination in order to increase efficiency in their work people. Of 1,000 employees of the Metropolitan Life Insurance Co. who were given careful medical examination, 245 showed defects in heart, lungs, and kidney. A recent examination of 100 postal employees, all of whom were at work at the time of the examination, shows that 12 of them were suffering from serious physical impairments, which were disabling until treated, and which required immediate medical or surgical attention; 53 showed advanced physical defects or impairments requiring systematic medical or surgical supervision and treatment; 33 showed moderable physical defects or impairments requiring medical supervision and treatment as well as hygienic correction, although the impairments were not necessarily disabling; and 5 showed moderate defects or impairments requiring hygienic correction or minor medical, surgical, or dental treatment which were not necessarily disabling. Not one of the 100 examined were free from some slight physical defect or impairment. Illustrations of this kind could be multiplied in the experience of other industries and will show conclusively what must be the method of the future if we are to reduce this type of morbidity and its resulting mortality.

I have referred above to the experience of the Metropolitan Life Insurance Co. with its employees. Out of every thousand examined 245 show marked defects of heart, lungs, and kidney. The group was placed under competent medical direction and advice. At the end of the year they were reexamined. It was found that 53 per cent of the impairments had practically disappeared. Nor is this experience unusual.

A study of a comparatively large group of policyholders who had been medically examined, subsequently advised regarding personal hygiene, mode of living, diet, etc., indicated most clearly a vast improvement in the mortality of this group over others who had not been examined and advised. There was a net saving of 28 per cent in the mortality of this group in a period of five years.

I believe there can be no question to-day that if this practice could be universally extended, if periodic health examination could be made a matter of common practice, and if it could be extended to the whole community and not merely to particular groups, we should find in a comparatively short time that the mortality of these diseases could be materially reduced.

As an example of what can be done along community lines the Framingham demonstration is typical. I have stated above that in the registration area the decline in tuberculosis mortality for the 10 years 1910 to 1920 was 27.9 per cent. In the decade prior to 1917 the tuberculosis mortality in Framingham averaged 120 per hundred thousand. In the year 1921 the mortality from this disease was 40 per hundred thousand, or a reduction of 66.7 per cent. Incidentally, there were marked reductions in the general mortality and in infant mortality. I am convinced that these improvements are largely due to the fact that during the demonstration nearly two-thirds of the population was physically examined. Many cases of disease were found which had previously been unknown. This was particularly true of tuberculosis. So far as it was possible, all of these individuals were advised and directed and instructed in matters of personal hygiene and correct methods of living. The results speak for themselves.

The point at issue is not whether periodic medical examination shall become universal or whether further data are needed to prove its value. The data already available and the results which have been obtained through such periodic health inventory and advice need no further elaboration. We are concerned now with the next step in procedure: What will be the practice of the future? Will it become the function of the community through its constituted health officials to offer such examinations? May we look forward to the time when such examinations will be available to the entire population in the same manner as we are now offering public-school education to our children? The city of New York is now spending upward of $35,000,000 per annum to educate its citizens. How much will this city or other cities be willing to spend so that coming citizens shall be not only mentally but physically sound and physically efficient? If this is to be a community problem, can they be taught that no wiser investment can be made than for such periodic inventory of the citizens of all ages?

If for the present this is not a community problem, will it be the problem of industry? Can the employer of labor be taught that efficiency and good health go hand in hand? Can he be made to see that from the standpoint of production poor health in an employee means financial loss to both the employee and to himself? Can he be made to understand that if the slogan of the modern industrialist, "100 per cent efficiency," is to be accomplished, the men and women working for him can not be below par physically? Can he be made to see that physical examination of employees is as directly a charge upon industry as the safeguarding and care of his other machinery?

Or, lastly, shall such periodic medical inventory be left to individual initiative? If such is to be the development of the immediate future, it will entail a change in medical practice to enable the individual to obtain adequate and competent medical examinations at a cost commensurate with earnings. This may involve a reorganization and readjustment of present medical practice. The limitations of this paper will not permit a more detailed discussion of this important matter at this time.

Whichever method may be finally developed to bring about universal health examinations, certain conditions are prerequisite. Of these probably the most important is the well-educated and thoroughly trained health officer. It is he who must bring the lesson of public and private hygiene and sanitation to every member of his community. He must be the guiding spirit in developing a realization of the need and value of periodic health inventory. Secondly, it will mean the training of medical men in the facts of preventive medicine. The physician of the new era will not only treat and cure disease but will greatly stress its prevention. Finally, there will be the education of the public itself. Without the heartfelt cooperation of the public, progress will be impossible. The public school must be the great health educator. Lessons in health must begin in childhood. The value of periodic health examinations must be ingrained in the child at the earliest moment. If we can combine the efforts of the trained and enlightened health official, the trained physician with a conception of the preventive side of medicine, and the intelligent, educated citizen for a common end, all understanding the value of discovering disease in its incipiency through careful, exhaustive, and scientific examination, we shall have taken the next great step in the lengthening of human life.

PHYSICAL EDUCATION.

Dr. JESSE F. WILLIAMS, *Associate Professor, Physical Education, Teachers' College, Columbia University.*

Only recently has physical education been considered as an aspect of public health. The years have given little encouragement to the ideas brought to this country by Lieber, Beck, and Posse, and only varying favor to the pleadings of Sargent, Gulick, and Wood. But following the memorable date of 1914, and in particular since the revelations of the selective service act of 1917, physical education has been viewed in the light of national needs. As typical of the newer point of view comes the report of the commission for the study of secondary education in which health and physical education are ranked first in a statement of "cardinal principles." The presence of the topic on a program for public-health specialists indicates a new emphasis in public health on physical education.

The importance of physical education to public-health specialists and to all educators is founded directly on five striking facts of human biologic and social development. In the first place men and women to-day share in the biologic inheritance of the race. Primitive man in the primordial mud and his successors, whether as arboreal or ground creatures, marked out for us for all time the physical and organic bases of life. The development of the muscular system and the subsequent rise and elaboration of the vital systems of the body determined the fundamental importance of physical activities for the individual. Modern civilization, shaped by economic needs, by artificial selection, tends to ignore the biologic story. The increase in functional nervous diseases, the disorders of the mind and personality, the increase in the chronic degenerative diseases of middle life propound serious questions for our civilization.

Secondly, the importance of physical education in the United States is to be seen in the history of our industrial development since the Civil War. The growth of industrialism and the factory system, the stripping of the home of occupations and activities, the segregating in shops, stores, and industrial plants of thousands who guide machinery with a minimum of physical effort, present not only problems for capital and labor but also problems in man's social development.

In the third place, the swing of the population from rural to urban districts constricts greatly the range and character of life. In 1800 only 3.9 per cent and in 1840 only 8.5 per cent of the total population lived in cities of over 8,000 inhabitants, as compared with 35 per cent in 1910 and over 50 per cent in 1920. This swing to the city has been accompanied by increases in the number of women and children engaged in industrial occupations.

In the fourth place, recent world-wide events give predilection to the belief that nationalism rather than internationalism will be the controlling policy of nations in international commitments. The reaction from the World War and its sequelæ have emphasized nationalistic aims and have cemented nationalistic programs.

And, finally, physical education, concerned as it is with activities of the child in which primitive impulses and desires are expressed, will remain the principal means for moral education of the young of the race. This is placed last in the group because of its importance. We may well consider that, after all, health, vitality, and national vigor are to be judged very largely by the uses to which they are dedicated. Moral education rests upon these immemorial racial activities and their expressions, and physical education forms the chief means by which such expressions may be guided to social ends.

Now, physical education has, hitherto, not enjoyed any wide recognition that was based upon its possibilities. Most programs for physical education in the school, college, or community are moderately antiseptic. Most of the efforts are combative and antidotal. Only occasionally is there set up a program that views physical education as a positive measure, and all too often is its value circumscribed by the conception of it as a corrective measure. The effort to use physical education as a corrective of bad schoolroom conditions is similar to the tendency to substitute belts for muscles, arch supports for ligaments. Contrariwise, we should think of physical education as an organization of activities to provide for children all that is needed for adequate biologic growth and development, and for necessary and acceptable moral education, and for adults maintenance of maximum efficiency.

I take it that public health is interested in physical education because of its health implications. Physical education has health values and possible contributions to health. But public health ought to see in physical education something more than the physiological results of exercise. Physical education bears the same relation to public health that it does to education in general. Public health is concerned with certain definite concrete responsibilities even as education is, but both are or should be vitally interested in the larger aspects of life in which the finest and best types of citizenship are the larger goals.

It is difficult to conceive of public health as interested only in disease prevention. The tremendous success of the efforts to control infant mortality and to decrease the toll of communicable disease is a handicap when the losses of vitality and early adult deaths are considered. The increase in the cardio-vascular-renal diseases, where their etiology is not parasitic or bacterial, indicates the necessity for viewing the problem as one of adjustment to the conditions of modern civilization, as one of high personal standards of living, as one essentially of education, hygiene, and physical education in which knowledges, habits, attitudes, appreciations, and ideals are to be our chief reliance.

It would appear, therefore, that public health may well consider how it can best serve in shaping a modern and dynamic view of health. Such a view must, so it seems, not hold physical education as a supplementary means to be employed as a corrective of life but as a fundamental scheme of physical activities for all, directed in accordance with the biologic, social, and human needs of boys and girls and men and women everywhere.

It would appear also that the public-health movement must view health as something more than freedom from disease. Health as freedom from disease is a standard of mediocrity. Health ought to be given a social interpretation. In fact all the special and technical procedures aiming at the welfare of the group need a social interpretation. With agreement on this point there will come new emphasis in our professional courses on health and hygiene. Technical sanitary instruction and disease control must be presented, of course, but hygiene as taught in our medical schools will be changed. Sterile sanitation and toothbrush hygiene will be interpreted in the light of national and individual needs, national and individual responsibilities.

The problem of proper emphasis is largely a problem of instruction and instructors. The traditional gymnast with his training all in his heels and none in his head has usually failed to sense the problem. The need for adequately trained leaders of physical education is very great. These leaders must know education, and just because most of the possible health work is done with school children in the school, it follows that public-health leaders must know education.

The tendency in educational administration to-day is to consolidate in one department the activities of physical education, health instruction, and medical inspection or supervision. Most school systems have, or seek to have, as the head of such work, a physical education specialist who is also a physician. The number of men so trained is very small. A present favorable tendency is to select as the administrative officer of such a consolidated department a man who knows education, physical education, and the problems of health. Men with a Ph. D. degree and adequately trained would be acceptable. Such organization would require that the medical supervision, as one phase of the general program, would be in charge of a physician, as chief medical inspector.

Such organization of educational administration would center in the board of education the responsibility for the health and physical development of boys and girls. In some places this is not done. In some places the school looks after the child's mind, the board of health looks after the child's health, and the park department looks after the child's play. This was logical enough when psychology and philosophy viewed the mind and body as separate entities. But the present general understanding that the child is a unity, that mind and body are one, renders such division of responsibility as absurd as the reported plan in the Federal Government where one department of the Government looks after the black bear and another department is responsible for the brown bear in our national parks.

Schools of public health could help tremendously in this problem of child health and child development by providing a training that would prepare men to head up such consolidated departments in our city school systems. Such schools would need to provide adequate instruction in the philosophy, sociology, and psychology of education, the history, aims, and scope of physical education with reference to modern developments and tendencies, and the means and methods of health instruction. The health problem in the child would be viewed as something immensely greater than transmissible disease prevention. Statistics show that not more than 4 per cent of children are excluded from school per year. On the other hand, from 60 to 70 per cent of children suffer from noncontagious defects that are severe handicaps not only for education but also for life. Such a course for doctors of public health would include in addition to the fundamentals in the sciences, instruction in educational hygiene, the hygiene of instruction, and the hygiene of childhood. Organic development, growth handicaps and hazards, factors influencing normal growth, and modern movements to promote child welfare would be understood. And, finally, we should hope that through it all there would be presented such a vision of human possibilities that health would come to be thought of in terms of service and worth-while work for the world. To suggest to you who know the public health field the larger possibilities of your work is, I know, to stimulate your thought, for your attitude has always been social and your password service.

INDUSTRIAL HYGIENE.

Dr. OTTO P. GEIER, *Director, Employees' Service Department, Cincinnati Milling Machine Co.*

I have enjoyed this discussion very much and I thank the men who have preceded me, particularly Doctor White and Doctor Green, and also Doctor Frankel, because they have partly told my story. They have emphasized in no uncertain way that what we must have in public health work is the machinery by which we may carry out the particular details of the practical application of preventive and curative medicine.

We must know that 1,170 lone health officers of this country can not effectively struggle with the problem of 110,000,000 people. After all, it is the average health officer, the average medical man, who must finally carry to the individual 110,000,000 people lessons of preventive medicine, periodic examinations, and so on. In speaking for industrial medicine, I believe that we have here a piece of machinery that offers great opportunities for the average doctor. The doctor in the field of industrial medicine has to cope with the problem of preventive medicine, periodic physical examination, and the other things we have heard about this morning which would bring about greater efficiency and a higher standard of living, thinking, and work.

May I say just this other word. I want to warn you men who have to plan these programs for the country to be careful not to plan in terms of the large city. After all, it is the small city that is your problem. The large cities plan for themselves. They have the means and the brains to work out their own problems. So in planning a public health program, it seems to me, that we must adjust ourselves to the work of the small city, and perhaps the larger units therein.

I have lost courage several times in the last few years in trying to emphasize and bring to the attention of the social engineers of this country the question of the value of industrial medicine. But recently I have taken courage from just one experience. On the way here I saw a former assistant of mine and he told me in the five minutes that we were together things that may be of interest to you. In an industrial plant where there are 2,000 men and women, equally divided, and where no industrial medicine had been carried on, excepting that of an industrial nurse, almost on the first day of his work 116 cases voluntarily presented themselves for attention. He found 4 cases of tuberculosis, 2 sinus infections, and a series of other focal infections—all on one day—besides the usual kind of cases that appear in an industrial dispensary. I believe that in an average good industrial clinic they see from 4 to 6 or 7 per cent of the employees in one day. Of course, no such thing occurs in private practice.

With the above day's work in mind we may agree with the following definition: Industrial medicine is the knowledge of medicine, surgery, personal hygiene, sanitation, and safety, as well as the economics and psychology of business management daily and intensively applied to groups, for the purpose of preventing and shortening disabilities due to illness and accidents, of adjusting unhealthful working and living conditions, of correcting unhealthy attitudes toward the job, thereby increasing individual efficiency, mass production, and contentment. Doctor Quimby, at Watertown, has reduced the average number of days of sickness from nine to three.

If periodic physical examinations, daily supervision of workers and working conditions, if early diagnosis of disease contribute anything to public health, to the clearing up of physical defects and inducing hygienic living, then the training of industrial physicians becomes a vital part of any economic health program and should be reflected in the education imparted to the modern health officer.

In support of this idea I would present the following statements which seem to be more or less axiomatic:

First. We are living in an industrial country, in the era of "The Iron Man," with the resulting problems of health and physical efficiency.

Second. The industrial physician is the humanitarian answer of medicine to the health needs of all groups in this era.

Third. A physician devoting his whole time to the health problems of industry will deliver more units of useful surgery, of diagnosis, of curative care, of preventive medicine, of educational hygiene both collective and individual, than can possibly occur in the private individualistic practice.

Fourth. Placing a physician in industry, in stores, banks, etc., makes health a part of the workaday life—adds it to the cost of doing business—puts health matters on a business basis.

Fifth. Consultation for diagnosis is encouraged by the industrial physician to a greater degree than by the practitioner because the industrial physician's failures stare him in the face daily; his uncured cases are advertised to all of the group, including the management.

Sixth. The industrial physician sees the human machine under a load test. He sees it gradually get out of alignment and makes repairs before a complete breakdown occurs. Before and after an illness he adjusts the load to the ability of the weakened human machine.

Seventh. In the supervising of as few as 5 per cent of those gainfully employed the industrial physician perhaps makes more physical examinations per year where no illness is involved than are made on the other 95 per cent of the workers. (Less than 3 per cent of the policyholders of the Metropolitan availed themselves of the free periodic examinations offered to them. Those that did accept showed 67 per cent reduction in mortality.)

Eighth. Teaching the breadwinner the worthwhileness of personal hygiene, prompt attention to minor injury and illness and the value of physical examinations, means that more money will be cheerfully spent on these same facilities for the members of the family for whom he or she provides.

Ninth. In case of preventable illness or accident under a system of industrial medicine the worker blames himself for the loss of wages and knows his employer is being robbed of production. In the other case, he usually curses his "bad luck" and feels that the physician in private practice is fattening on his God-sent misfortunes.

Tenth. Industrial medicine is one of the safe, sane stop-gaps between whatever is unsatisfactory in the present system of medicine and that much heralded socialized medicine. It supplies the economical advantages of the organized treatment of large groups, but preserves the real values of the individualistic competitive system. Our statecraft is of such low grade that we should desist from overloading our ship of state until the present political leaks are stopped.

Eleventh. Industrial medicine now supervising perhaps 4,000,000 workers and employing the part or whole time of possibly 2,000 physicians has developed in spite of the indifference of our medical leaders toward this specialty and has attracted many good men despite the patronizing attitude of the profession at large. It has succeeded in the face of this opposition because it is economically and socially sound.

Twelfth. The sanitarian should be the strongest proponent of the extension of industrial medicine, which is applying preventive medicine, collective and individual, in its most intense form—compelling periodic physical examination and demonstrating the value of the prompt seeking of medical attention and early diagnosis. Sanitation and the detection of contagious diseases and of sources of occupational disease add further argument to the value of the industrial physician's work, to say nothing of his ability to furnish reliable morbidity statistics covering large groups.

Thirteenth. If mortality and morbidity are to be reduced to the minimum it must be through the more direct appeal to individuals to observe the laws of personal hygiene, to avoid quacks and nostrums, and to seek the physician's aid early If such interest be placed on an economic basis, as in industry, this program will be definitely accelerated.

In closing, we must, as I have said, be careful that in planning for the education of the public health officer that we do not think too much in terms of the needs of large cities. Our purpose to-day is to lengthen the span of life by assuring positive health, increased bodily and mental vigor, so as to increase the pleasure of work. We must improve the environment of work and of living from the physical and mental point of view. To increase the comforts and conveniences of the average man we must increase production, for, after all, society greatly depends on those who work with their hands. Here we find the greatest neglect. Therefore to raise the general standard of living we must apply our energies and life conservation to these groups whom we will find most ready to accept our teachings. This instruction can best be given during the working hours, when the minds are most impressionable.

Interest in personal hygiene begins with the revelations of the physical examination. Gunshot prescriptions in personal hygiene, fired at the mass of people, do not hit the target. The science of right living follows knowledge of the needs of the individual discovered by physical examinations and not by mind readings. The industrial dispensary, with its physical examinations and opportunities for daily follow up, with its accessibility to the patient for minor ills and complaints, is perhaps the only machinery to-day that determines the extent and character of physical defects of adult groups of individuals, and which also is ready not only to educate but actually care for those physical and mental needs, or to see to it that the specialist and others are consulted.

The industrial physician is the countercurrent against intense specialism inasmuch as he enjoys that very valuable personal relationship of the general practitioner to the individual, where the sense of touch, eye, ear, and hand combined with a friendly relationship with the individual, a knowledge of his job, and an ability to measure his efficiency in that job, to know his mental reaction to the job. These frequent contacts and observations, occurring in the industrial dispensary, do more perhaps to actually bring the man to his highest capacities for enjoyment of work and life than result from the spasmodic attention, the shuttlecocking from specialist to specialist.

If every public health officer, every professor of hygiene and preventive medicine, every specialist, every surgeon, would spend several days a year in a good industrial clinic, his viewpoint of medicine as a whole and of the application of his particular specialty to the masses would change. These specialists would appreciate that the prompt education of a large group of industrial physicians would be the best way of taking the pressure off the public health officer, at the same time supplying a greater number of people with adequate medical service. All phases of industrial medicine should be brought into the schools of public health so as to give the student a slant on workaday life—to see preventive medicine, physical examinations, and curative medicine closely combined.

PUBLIC-HEALTH EDUCATION.

Dr. C. E. **Seashore**, *Chairman Division of Anthropology and Psychology, National Research Council.*

I wonder how many of us feel well qualified to go into the job of public-health education after listening to this morning's program. It is particularly gratifying to notice the distinct trend away from the material attitude and from the attitude of formal instruction, and this health movement carries this symptom together with many other movements which are going on at the present time. What has been called natural evolution for the determination of society seems to be passing, and the deliberate voluntary control of social evolution seems to be the program ahead of us and this is a large part of that movement. It is particularly gratifying to look forward not only to the remedying of disease, not only to the prevention of disease in those who come up to the average standard of to-day, but rather to human betterment. In my State of Iowa we have had a slogan which I had the pleasure of starting in more than one community: "Better average children in Iowa." I would say, "Better average men and women" should be our slogan in health education.

Now, I have formulated a very brief statement from the point of view of the psychologist as to what can be done to help the educator to organize this program.

From the psychological point of view the first fundamental need in the organization of health education is a job analysis, i. e., a critical and constructive inventory of the situation showing, in profile, the various aspects of man toward which health education should be directed and the means at our disposal.

This inventory should yield a classification of the now recognized objectives of health education, carefully weighed as to relative prominence, and should fill the gaps representing neglected, unrecognized, and unknown objectives as deduced from a careful survey of the sciences, arts, and conditions which influence the health of man. Such a survey would throw into relief, first, a classification of the health acts and situations to be reached; second, an inventory of the motives, means, and avenues of personal appeal; and, third, the environmental approaches.

A good beginning in the first direction is Dr. McPhee Campbell's chart of the levels at which mental disorders may appear. Such a scheme should be extended so as to cover in a skeletal outline all the disorders to which man is subject and, in so far as possible, some indication of the interrelations of these. This is within the province of medicine; but the problem should be solved with reference to the needs of health education, and thus becomes a pedagogical problem. Such a schedule of objectives should be popularized and adapted for all levels of instruction in order that teachers and those to be taught may actually acquire a clear conception of our objectives. Such a clarifying of the objective is also one of the most effective means of instruction and personal guidance. It gives orientation.

Parallel with this outline of objectives should be the outline of motives and means of influencing men. It is one thing to teach the laws of health; it is quite another to make this knowledge mold the emotions and impulses and pave the way for right action. The demand is not so much for knowledge as for a motivation of health activities.

Parallel with these two reliefs we should have a relief of the means of betterment of the environment in the interest of health. This is strategic not only because a healthy environment is essential to good health but pedagogically because nine-tenths of the people readily grow enthusiastic about the betterment of the environment where they might resent suggestions of direct self-betterment. This approach has the advantage of being concrete, tangible, and satisfying.

Give us a job analysis showing the possible approaches for the betterment of the health, not only in sanitation but also in orderliness, comfort, and beauty, and we shall have one of the most effective approaches to the health betterment of man. Indeed, it would be an interesting experiment to determine how the personal health and happiness of a people might be changed by a cooperative program of civic betterment of the outward conditions of health. A good example of this is the campaign against infant mortality so successfully conducted in some quarters. Pedagogically it is important that this environment betterment should be a cooperative affair, arising so far as possible from initiative within the social group itself; because it is only in participation in activities of this kind that the individual really feels himself into the movement. Federal, State, corporation, and other official betterment of the environment often fails to reach the individual and even fails to be appreciated. But let us educate the individual to initiative and give the social group of the community the feeling of responsibility and the joy of achievement, and the individuals will identify their personal lives with the environmental improvement. It is worth while for the sanitary engineer to investigate this principle of pedagogy; and the educator should know where to begin education; namely, by teaching the people to do these outward things for themselves. Pure-food agitation would be a good example.

In the second place, we need to make personnel specifications in health education somewhat on the order of the specifications now being formulated in the United States Army for the division of labor, for determining fitness for each branch of service, for organizing training for each unit, and for integrating the various branches of service.

There was a time when the shoemaker in the village not only shod both men and horses, but pulled their teeth and preached in the meeting house. As industry has differentiated, so health education must be organized into a large number of coördinated specialties: each with a knowledge of the other; each respecting and profiting by the efforts of the other; each the exponent of its most highly developed science, art, or skill; and this must be done in the spirit of science and not of formality and officialdom.

This is the opportune time to take an inventory of the health promulgating agencies of our day and thereby secure two most desirable things—the division of labor, and cooperation.

It is now recognized that teaching requires professional training. We must therefore recognize and specify professional training for the teachers of health education, and we must provide for the specialized training of officers for the direction of civic health betterment through various forms of sanitation, and other health promotion.

We need, in the third place, a critique of specific methods and means. By the introduction of scientific methods of analysis and motivation of the task more advance has taken place in the teaching of reading, spelling, and arithmetic in the last twenty-five years than in the previous twenty-five hundred years. The more complex the object, the more need there is for logical designing and experimental evaluation of the medium, the method and its results.

Recent studies in the field of motion-picture films in sex education show the enormous complexity of the situation and the countless dangers inherent. Telling a child not to do a thing is often an inducement for him to do it. Exposing the horrors of a situation often stimulates the instinct of exploitation. What is grateful knowledge to the ignorant person may be an insult to a cultured man. Familiarity with effects tends to make them commonplace. Intense fear may aggravate nervous disorders.

At present we do not know whether, on the whole, the films now used are having a good or bad influence; but that is no reason for abandoning them. It should merely stimulate us to a rigid and constructive experimental procedure in the adaptation of this extraordinary avenue of appeal; and in this we have much to learn from the films which to-day are most influential in corrupting public health. For the laws for learning the good are very often the same as the laws for learning evil.

We must learn especially how to give health acts a setting in what to the young in particular is regarded as good fellowship, good nature, propriety from the point of view of the group, generosity, bravery, courage, competition, and reward. We must use the leverage of humor, laughter, scorn, ridicule, just at the level at which there is a spontaneous outbreak of the person appealed to. We must not forget that self-control and self-direction can not be taught in one lesson nor ten. It is not fair to expect marked, positive good from the showing of one film, no matter how impressive or instructive it may be. It would be the utmost folly to depend mainly on the counterattack through films. We must motivate the source of corrupt films not only by judicious censorship, but more effectively by soliciting the interested cooperation of the professional entertainers in the promotion of the health program for the public. We already have this in part, and by organized, sympathetic effort it can be extended with extraordinary effect. Film to-day is a most effective teacher because it is not regarded as teaching, but as entertaining. It deals with actual life in the concrete; it sets the tone of the community. If we can get the movie audiences to laugh and weep at the right thing, we shall be touching the sources of conduct.

In brief, I have tried to point out that in the interests of health education we should have a thorough clarifying of the health objectives, of the means of influencing men for health, and of the methods of working through the environment. The organization of health activities, shown in their true relations, requires personnel specification for division of labor, for determining fitness, for organizing training, and for integrating the various types of service. The work so organized will then proceed through systematic, educational experiments, testing methods and means.

Each of these activities in human engineering requires a knowledge of normal human nature. This fact has been neglected with obvious results. It is being neglected at the present time in institutions which train health officers. I therefore enter a plea for the recognition of training of health educators in psychology regarded as the science of human behavior, the explanation of its nature and laws, and the direction of its forces.

DISCUSSION.

Chairman, Dr. William H. Welch:

There remains some time for discussion. I think it is very desirable that several here in the audience should have an opportunity to participate in the discussion, so I trust that those who are assigned for the discussion will not take more than five minutes apiece. May I volunteer the suggestion that I trust the discussion will relate very largely to the problems of education, training for health officials, and, of course, for those going into any other activities in the health line. The subject for the morning is essentially the educational side of our topic. Doctor Ravenel will open the discussion.

Dr. M. P. Ravenel:

I believe we all will agree as to the essential truth of what has been said in the admirable presentations to which we have just listened. It is, however, evident that it would be a very wonderful man who could acquire expert knowledge of so many different subjects, especially in the length of time which is usually allotted to one's education. Should such an one be found, he would be a macrocephalic monster, and not much use as a health officer It must also be recognized that the time allotted does not allow of any full discussion of so broad a field. I will, therefore, confine myself to a few practical points.

Admitting, as we all do, the essential facts which have been presented to us, and their value to the health officer, it must be remembered that what we need is a practical man—one who combines fundamental knowledge of these subjects with common sense, and the ability to put his knowledge into effect. The health officer must be a man who is fitted to translate research into practice, and who can carry to the common people, in language which they can understand, the message which the specialists have formulated.

I deprecate the multiplication of degrees. For practical purposes, the two outstanding ones are sufficient—certificate or master of public health and doctor of public health. What we need is a degree which will certify to the average public a man's qualifications for the position of health officer, and will guarantee to them that he has pursued courses of study which fit him to be the guardian of health in a certain community.

I would lay special stress on the personal qualifications of those desiring degrees in public health. Not only must the health officer be a master of the material which is furnished to him by the schools, but he must have personal qualifications which will enable him to be a leader in his community; a teacher not only of the public but of the medical practitioner. I am one of those who believe that the medical degree should be a prerequisite for any public-health degree. In the future, when we have obtained an abundance of health officers who have added this special training to their medical degrees, it may be advisable to allow others who have taken certain medical studies to take also the doctorate of public health. In view of the condition of things as they are at the present time, a medical degree seems to me to be necessary.

In the training of medical men and health officers, too much stress has been laid on contagious disease and its prevention and not enough on good health and general fitness. Even the terrible influenza epidemic, which cost so much in money and in the lives of those who would doubtless have become useful and even great citizens, has not left any scar on our Nation at all comparable to some other diseases which bring about incompetence and dependency. It is the cripple who is a drag on the Nation and not the man who is gone. We have in the past spent too much time teaching men physical examinations for the detection of disease and too little time in teaching such examination for health.

It has been pointed out that teaching along almost all lines is too far removed from practical application. As in medicine, so in public health, it takes the graduate a long time to find himself and to learn the application of his knowledge to practical matters. The English system of training medical officers of health obviates this to a certain extent, and it would not seem difficult to devise ways in this country by which the aspirant for the position of health officer could be farmed out, as it were, to learn the actual practice of public health work. We have, in our Public Health Service, the largest and best trained body of sanitarians in the world, engaged in public-health activities of every sort. Surely, some plan can be found by which students could be placed in different divisions of this service for practical training.

In closing, I would once more emphasize the importance of selecting students. I could wish that the psychiatric tests, which Doctor White has spoken of, could be applied to all applicants entering schools of public health. The health officer should be fitted to his job. I would exhort the bishops and other officials serving in the Temple of Medicine to apply to students what an English poet advised in regard to students of the church: ''Lay not careless hands on skulls that can not teach and will not learn.''

Dr. Willard S. Small:

Doctor Welch has limited us to five minutes and said that we should discuss some matter relevant to the program. It would be difficult to discuss anything not relevant to the program, as the universe has been pretty well looked over. But I want to confide to you that I was not given any liberty of choice; I was told to discuss the last topic just presented by Doctor Seashore. In doing this, I must adopt, because of the time limits, the dangerous expedient of making unqualified statements when every statement should be qualified.

Now, I am in full agreement with everything that was said by the last speaker, Doctor Seashore, and I have very little to contribute.

I want to say this, however, that we must get a better idea of what public-health education means.

In the past as the term has been used it has too frequently meant nothing but propaganda. It has meant selling public health knowledge to the public. And the methods employed have been advertising methods, good or bad, as the case might be. Judging from the results, except in certain specific instances, they have not been very effective. Doctor Seashore, of course, is right in saying that all these methods by which we attempt to sell public health knowledge and faith—because it is that—must be subjected to reexamination. After all, propaganda means nothing but creating faith or supplying faith. It means nothing but influencing the mass consciousness for that purpose and making mass consciousness assent to and conform to certain things that we want done. You, as public health workers, want certain things done; you want your public to react in a certain way.

Now, I have little faith that propaganda alone is going to get you very far. In my opinion, the really important things in education are not achieved by bold and unsupported propaganda methods. They are not brought about that way. They are brought about by long, intensive, and carefully planned efforts in education. Somebody referred to the fact that it took the world 50 years, two generations or more, to assimilate the new knowledge brought back to Europe by the discovery of America. It is going to take us a longer time than that to make generally effective the new knowledge of science, which is the working material of those who are to choose careers in public health. The influence of personal contacts, industrial physicians, social workers, and family physicians will be unseen but potent.

One other thing I want to say is that if we are to have an assent on the part of the public that will be thoroughly effective for you, it must come through the education in health of that which we are pleased to call the educated part of the public. Even if it were possible to win the assent of the mass of the public by unaided publicity methods, it will not be possible to get over effective programs until the educated part of the public, the few leaders in every community who set the standards and give the momentum, are genuinely educated in health. We have got to reach the higher educational institutions which educate that 10 or 15 or 5 or 1 per cent who are leaders of communities, in order that they may be intelligently and scientifically furnished with respect to personal and public hygiene. If we can do that, we shall have on the part of educated men and women the basis upon which the public health official can depend for assent and consent to essential programs and for dynamic power in the community in getting the programs over.

Dr. Donald B. Armstrong:

I need not say that I can not claim to be the wonderful five-minute man that Doctor Ravenel spoke of, so I shall take up very little of your time. It seems to me that out of this series of admirable papers have come two or three points that would bear emphasis. The first is the question of qualitative standards, to which both Doctor White and Doctor Smith referred. In particular, there is the necessity in our medical schools of teaching the physicians not only to recognize disease, but also to be able to examine for health.

There is also another important point that has not been touched upon so extensively and that is a question of quantity rather than quality. If we are to have, as Doctor Frankel urges, universal medical examinations, if we are to have in our schools and industrial establishments the thorough medical and nursing work which is necessary, if disease is to be detected in its early stages and if hygiene is to be encouraged, an adequate supply of physicians or sanitarians for this work greatly beyond our present resources must be created.

Finally we come to another point that has arisen in my mind out of Doctor Seashore's paper, the question of the application of modern psychology to public health education and public health work in general, and in particular the economic and social aspects of our problem. There is a relationship between the economic status of individual workers and their health. There is an ascending stairway, good wages lead to good health, and a descending stairway of poor wages and poor health leading down to disease. Now, that is one side of the problem. The other side is this: How are we going to make sure that the worker makes use of an adequate income for health? That question applies to you and to me and to all of us. It is a question which I think we are always up against. Therefore, we must look to psychology to tell us how to find a motive force that will make our knowledge of hygiene effective for the individual and for the improvement of community life.

Dr. Hermann M. Biggs:

I just want to say one or two words first, in reference to Doctor Freeman's excellent address, in regard to the date of the beginning of the modern public-health work in the United States. The date was given as 1900. That is a serious mistake, I think. The activities of the New York City health department began in 1890. The tuberculosis work began before 1890; the public health laboratories were established in 1892. Child hygiene was going even before 1890 and the tuberculosis work was very actively going on long before 1900.

Then it seems to me that the significance of the public health laboratory in the development of the public health in the United States and the present situation was not sufficiently emphasized.

The public-health laboratory in my judgment is the most outstanding feature of the public-health work in the United States and it has influenced and it is bound to influence the future fundamentally.

I wish to disagree with almost everything that the last speaker (Doctor Small) said; all the things he said about educating the leaders in order to develop public-health education. It seems to me that we have accomplished almost everything by propaganda. The achievements have been outstanding. No one who commenced public-health work 30 years ago could possibly be uncertain about the achievements that have been brought about. They have resulted from propaganda and from nothing else. The death rate in New York City from preventable diseases has been reduced 50 per cent. This has been by the education not of the highest class, but of the lowest class. The speaker is going to educate the few leading men in the community. They are the last ones that I should deal with. The proper thing is to educate the children and the population of the tenement houses, and when you have taught them you can turn to the so-called educated groups. Last of all comes the medical profession. The most difficult element of the population to teach is the medical profession. In New York we have not found that we could bring the medical profession into line by direct attack. First we educate the tenement-house population and teach the children. They will teach their parents. The parents in turn teach the medical profession. You can teach the mass of the people and they will teach the leaders.

Chairman, Dr. William H. Welch:

I was impressed very much by the statement made by Doctor Freeman. I understood him to picture the general average, and he was very careful, I think, to safeguard his statement with a few exceptions, and New York City would certainly have been one of the exceptions.

Dr. George M. Kober:

The achievements of hygiene and public health in the United States are certainly very gratifying to all interested in this movement. Much has been accomplished and much remains to be done. There is certainly need for additional health officers in a great country like ours, and the question is how this supply is to be assured. We all know that the average young medical student is of a sympathetic nature and that courses can be arranged to appeal to these students in the medical schools. I believe that certain influences with which he may be surrounded can be called upon to interest him in the prevention of diseases, because after all the highest aim of scientific medicine is the eradication of preventable disease. With such an attitude of mind the student would not find it a bore to listen to a regular systematic course of hygiene, and undoubtedly these courses will stimulate interest and enthusiasm in preventive medicine. This much every medical school and professor of hygiene owes to the public. Much can be done in undergraduate courses to prepare the way for subsequent training in public-health work. With two well-endowed schools of public health now in existence the opportunities for proper training for a special career are certainly ample. I believe the demand for full-time health officers will be fully met and quite a number of cities may be willing to pay a fair salary and make such positions more permanent.

A more important and difficult problem is what can be done for our rural districts. I feel that many young medical men would gladly enter the field if they were assured of any adequate wage. How can we make it possible for such men to take up public-health work and make a living? The answer would be the employment of salaried men with privilege to engage in private practice. You all remember that Robert Koch, one of the greatest leaders in scientific medicine, was nothing but a county physician and health officer, and while so engaged also did great things which placed him in the front ranks in medical science. All that is really necessary is for a man to be interested in science and the ways and means will be found. But I suggest, in seeking a solution of the problem, some expression should be given by this body that the people of the Nation owe it to themselves to provide competent health officers and country doctors and to assure them an adequate living.

Chairman, Dr. William H. Welch:

The subject Doctor Kober has brought forward is one of first importance. It is a subject which it is essential to consider. I think it is included on the program later. It is perfectly obvious that unless rewarding careers are open to those who have spent time and money in getting the necessary extra training no matter what opportunities may be provided we shall fall very far short of our aim.

I would like to hear a point touched upon that seems to me of rather fundamental importance, namely, how can we systematize the methods of practical training for those who are engaged in study in our schools? It is perfectly obvious that the organized health departments of a State, county, and municipality, the public health laboratories attached to them, and also the hospitals for infectious diseases must furnish for students of hygiene and those contemplating careers in public health the sort of training which ordinary hospitals do for medical students. But it has got to be systematized; it has got to be better arranged and made more generally available. We are hoping in connection with our school in Baltimore to secure an area in the city which will be of course under the city health department but in which the health authorities will be aided by the school of hygiene. Possibly other teaching areas for the study of certain problems may be secured. I agree with the importance of emphasizing training in a small town and rural hygiene, and believe rural areas should also be secured.

I would like to have this matter discussed if possible. How can we secure for our students at least three months of practical training right in the field which will in a way correspond to the training afforded medical students in our teaching hospitals?

In some way the various organizations must cooperate with the schools in order to enable them to supply this training. The English system of training for the development of public health officers is very good so far as it goes. But I should hope that something more than mere apprenticeship training would be provided. They are waking up to the situation in England. I would like to hear any discussion along that line. Can we have something corresponding to teaching hospitals for medical schools in the way of teaching physicians in the various governmental health organizations?

Dr. Alexander C. Abbott:

We are trying an experiment at Pennsylvania. Whether it will work out successfully or not I do not know. The health department of the State of Pennsylvania—I speak only of Pennsylvania—and the health department of the city of Philadelphia put at my disposal all their facilities and enable me to send students who have been fundamentally trained to serve an apprenticeship. I like the word "apprenticeship" because that is precisely what I want. The apprenticeship may be good or bad according to the manner in which the work is controlled. If a student be placed in certain of the divisions of the departments of health that I know in my own city and State and no warning given to him, I can imagine that a good deal of what we have done for him may be destroyed. My plan has been to place students in such divisions with the requirement that they give to me at the end of their apprenticeship a written criticism of all they have seen. Such criticism will be evaluated for the degree or diploma toward which they are working. That plan, up to the present, has put the students on their mettle to such an extent that most of the defects are readily seen and often constructively criticized. I do not know how the method will turn out ultimately, but I believe it is worth trying further.

Dr. M. P. Ravenel:

About 10 years ago I took this matter up before the Public Health Association. Before doing that, I corresponded with the Surgeon General of the United States Public Health Service, which is doing every sort of public-health work, and so would be particularly valuable as a training agency. I would like to ask before this conference adjourns whether the Surgeon General can not inform us concerning the possibility of using the Public Health Service for part of the training of public-health officers.

AFTERNOON SESSION, MARCH 14, 1922.

REMARKS BY THE PRESIDING OFFICER.

DR. HUBERT WORK, *Postmaster General, United States.*

General Cumming asked to say a word himself, giving as a reason, "I want to tell these men what a great man you are." If you will notice, it took him less than a minute to cover the subject. [Laughter.] I am encouraged by his reference to my different occupations to hope that because of my diversity of interests you will not expect a long speech or a very scientific one.

Curiously enough, in the period between the time when I first began to study medicine and the time when I ceased to practice, I saw the field change from curative to preventive medicine. There is no general practice of medicine, nor branch of it, as pursued in these days which does not have for its ultimate object prevention. The whole system of medicine resolves itself in its last analysis into preventive medicine. We instruct how to prevent acute diseases; to prevent contact by infection and by contagion wherever possible. If disease does occur, our whole effort is to prevent sequelæ that may be dangerous or disabling after its acute stages have passed. If there are conditions that must be corrected, they are taken up by practitioners of medicine and relieved if possible. Even this is in line with preventive measures. It may not be its immediate purpose to prevent death, but to prevent disability or death coming indirectly, through impairment of health. The removal of adenoids from a child, or of the tonsils, now a common recognized practice, is really preventive medicine.

The greatest exponent of preventive medicine is the United States Public Health Service. Recently I heard a very distinguished man say at a dinner that the United States had the best equipped and most efficient Public Health Service of any country in the world. I did not realize it had attained to such distinction. I realized its efficiency and responsibility in what it was created for. Its functions originally were those of quarantine—quarantine, of course, as locally applied and also applied between nations. But during the late disturbed period of war the United States Public Health Service went through the most trying period of its existence. It was asked to do things that it was never intended it should do, and to do them without sufficient men or adequate appliances. Yet it did in a remarkably acceptable way work that was quite foreign to its previous duties.

Medical education when I first went to medical school was all directed toward curing disease. We at that time called it "curing diseases," although we later became more modest and stated that we "cured" nothing, but "assisted" in recovery. However, the diseases which we were taught to diagnose, recognize promptly, and to treat have almost disappeared. In the first few years of my professional life I was largely supported by typhoid fever. Now it is a rare disease. I recall the first year of my practice when I was 40 miles from any other physician that I went through an epidemic of diphtheria with a mortality rate of 40 per cent—not considered extraordinary at that time. Now that could not occur. Typhoid fever has been or can be abolished, and the death rate from diphtheria is very low. The day of preventive medicine is here, and it is the duty of physicians to encourage educational schools to instruct their students thoroughly in preventive medicine.

We have developed curative medicine well toward a point of perfection. We must now turn our attention to the development of schools for public-health officers and for sanitarians and to bring them up to the demands of the public. The public has advanced really further in their conception and their sense of the necessity of preventive medicine than has the medical profession. It now acts promptly if it anticipates some pending disease in order that the people may be protected. The medical profession should advance with the people and teach them what should be done to prevent disease or its sequelæ.

I was going to speak of irregular practitioners; the pathies and cults and those associations that feel it necessary to attach some prefix to their names to distinguish them. They are opposed to preventive medicine and to the contribution of funds by the Government to the Public Health Service. We would like to assume that they do not understand that all of this money is spent to prevent disease. The difference between the purposes of the quack and of the physician may be summed up in this statement: The physician prevents disease; the quack invents it and preys upon it for his own financial advantage. There never has been a time within my recollection when the cults and tradesmen using medical titles for the purpose of furthering their business were more active and less effective than now. The public has educated itself, but I think it wise for physicians, whose first object is to prevent disease, to realize that it is time they get this fact before the public and demonstrate that this is their purpose and that they are not waiting around until disease occurs with the idea of curing it for a fee.

III. WHAT KIND OF SANITARIANS ARE NEEDED FOR THE FUTURE?

INTO WHAT SPECIALIZED FIELDS WILL PUBLIC-HEALTH WORK BE DIFFERENTIATED IN THE FUTURE AND IN WHAT COLLEGES AND PROFESSIONAL SCHOOLS WILL MEN FOR THESE VARIOUS FIELDS BE TRAINED?

C.-E. A. WINSLOW, *Professor of Public Health, Yale School of Medicine.*

It is essential in considering the problem of the training of sanitarians to recognize at the outset that public health is not a definitely delimited discipline, an individualized branch of science like chemistry or mathematics. It is rather a field of social activity employing diverse groups of specialists for a common aim. When we employ the term "public-health worker" we are using a classification based on objectives rather than on technique, a regional not a functional classification.

In attempting to enumerate the different types of specialists involved in the modern public-health campaign it is easy to elaborate a list of public-health workers so extensive that our ambitions seem to embrace the entire range of human thought and action; for the field is a temptingly inclusive one. I shall limit myself this afternoon to the clearly differentiated types of public-health workers who are to-day actually employed by State or municipal departments of health and of education and by voluntary public-health organizations. Even with this limitation one can not avoid the enumeration of more than a dozen separate types, which may be grouped for convenience under four main heads according as their basic interests concern: (A) the human body; (B) its nonliving environment; (C) its parasitic foes; and (D) the social organism of which it forms a part.

(A) Specialists whose viewpoint and training are primarily concerned with the human body and its functions.

1. *The physician.*—The physician has always been the leading figure in the public health campaign, and if I am correct in my estimate of the tendencies of the present day the growth of public dispensaries and other agencies of State medicine will inevitably produce a closer and closer approximation between the fields of medicine and public health. Official health authorities and voluntary groups interested in the public health will more and more tend to practice medicine and the private practitioner will to an increasing degree become an auxiliary in the public health campaign.

2. *The nurse.*—The nurse is second only to the physician in the conduct of the public health movement at the present day. She is par excellence the teacher who carries the gospel of health into the individual home, and I am convinced that by far the most efficient type of public health nurse is the nurse who combines with her educational work the actual care of the sick on an hourly basis. Here, even more than in the case of the physician, it is clear that the principal energies of the nursing profession will steadily and surely be incorporated in the public health campaign.

3. *The nutrition expert.*—With the present emphasis on education in nutrition as a basic factor in the promotion of health the expert on nutrition is becoming an essential factor in the work of health centers, visiting nurse associations, and the like, and will almost certainly in the future be frequently employed by the official health organizations of city and State.

4. *Expert in physical training.*—The specialists in physical training employed by departments of education may very logically and properly be considered as members of the army of public health.

5. *The dentist.*—The dentist and the dental hygienist must naturally be recognized as essential factors in the machinery for safeguarding the health of the community.

6. *The psychologist.*—In addition to the medical man who specializes in mental disease and mental defects, we frequently find men and women trained specifically as psychologists assisting in the mental examinations which are so essential in the control of diseases of this type.

(B) Specialists whose viewpoint and training are primarily concerned with the nonliving environment of man.

7. *The chemist.*—The chemist, specializing in the application of his science to problems of water supply and sewage disposal, food control, and the testing of disinfectants, has long been a fundamental factor in the scheme of health organizations. His importance is relatively less great than it was 20 years ago, but in the laboratory of every State and large city he must always find a place.

8. *The sanitary engineer.*—In order to avoid unduly complex classification I would include under this heading not only the engineer who has specialized in water supply and sewage disposal but also the heating and ventilating engineer and the specialist on building construction—all workers, in short, who deal with the designing of material structures primarily from the standpoint of their effect on health.

9. *The inspector.*—We may naturally place in this general group one of the most important and most neglected figures in the whole public health campaign, the inspector in the control of sanitary conditions and in the supervision of food supplies. There is urgent need for a large group of men or women who do not necessarily require a college education but who do need substantial training of an elementary kind for which as yet no provision whatever has been made in the United States.

(C) Specialists whose viewpoint and training are primarily concerned with the parasitic enemies of man.

10. *The bacteriologist and the protozoologist.*—As in the case of the sanitary engineer, I am using this classification in a broad sense to include all workers whose fundamental interest lies in the micro-

scopic world of life. Here will come not only the water bacteriologist and the milk bacteriologist but the student of tropical medicine, of pathology, and of immunology if his work be primarily along microbiological rather than medical lines, and also a small group of specialists concerned with the study of microorganisms which cause taste and odors in water supply. Obviously this is a group of supreme importance to the public health, ranking in this respect with the physician, nurse, and sanitary engineer.

It will be noted that I have made no place in this tentative classification for the epidemiologist, as I have never been able to convince myself that epidemiology was in fact a distinct and separate discipline. The etiology of disease may be approached either from the standpoint of the physician or the standpoint of the bacteriologist or the standpoint of the statistician, and most epidemiological investigations can be naturally grouped under one or the other of these three heads or a combination of the three. Epidemiology, like public health as a whole, is a field rather than a method of work.

11. *The entomologist.*—A minor but important specialty in public health is that of the entomologist who will be called in as an expert and occasionally employed by a health department, particularly in the Tropics, for the study and control of insect carriers of disease.

(D) Specialists whose viewpoint and training are primarily concerned with the social environment of man.

12. *The sociologist and the social worker.*—The most advanced voluntary public-health organizations of the present day, such as hospitals, dispensaries, and visiting nurse associations, are already employing specialists in social diagnosis and social readjustments to deal with the economic and social factors which play such an important part in the causation of disease. Here, as in the case of the nutrition expert, it seems certain that public authorities will expand along similar lines in the near future, so that the social worker must be recognized as an integral part of the public health campaign.

13. *The statistician.*—The statistician as a figure in the public-health movement is as definitely established and as important as the bacteriologist and the sanitary engineer.

14. *The lawyer.*—Specialists in sanitary law are not numerous, but in the development of city and State organization and in the teaching of public health there must always be a place for the expert of this type.

15. *The expert in public health propaganda.*—As the public health campaign has become more and more consciously a campaign of education the larger State and city departments have begun to employ specialists in the technique of publicity. This is another field which is certain to grow and expand in the near future. The

technique of lecture service and the organization of exhibits, of motion pictures, of newspaper and other publicity is a technique which can only be fully mastered by one who devotes himself preeminently to this special type of service.

The most conservative classification of public health workers must, I believe, recognize at least the 15 types listed above, and I am sure that the enumeration errs on the side of omission rather than on that of too great inclusiveness. It will be noted in particular that I have made no mention of the public health administrator and of the teacher of public health. I have omitted these two workers because I have tried in this outline to define definite functional fields of activity and because the administrator and the teacher must deal not with the functional field but with the application of all or sundry of the specialties that have been indicated above. The public health administrator and the teacher of public health will in general receive his basic training in one or the other of these specialties and with one or the other of these viewpoints; and as his knowledge broadens through experience or through postgraduate education he will gradually assimilate and correlate the various factors in the general problem.

In the past the public health administrator has generally received his first training either as a physician, a bacteriologist, a sanitary engineer, or a social worker, and men from all of these disciplines and others will continue in the future as in the past to earn through native merit and the power of growth the right to serve in administrative capacities. It is obviously possible, however, to devise a special type of training which will combine those elements of medicine, of bacteriology, of sanitary engineering, and of vital statistics which are most essential for the sanitarian and will directly prepare the student for administrative responsibility in the public health field without making him at the same time a qualified physician or a fully equipped sanitary engineer or a specialist of any other kind. The lack of men combining medical and sanitary training in the past has made the development of such courses seem imperative. My own teacher, the late Professor Sedgwick, was the pioneer in this field, and shortly before his death he urged that medical schools should be reorganized on "the Y plan" so that after two common years the students should in the last two years diverge either to the degree of doctor of medicine or to the degree of doctor of public health. Whether this type of special training for a nonmedical doctorate in public health will prove wholly adequate or whether the tendency will be rather toward a course of perhaps five years involving the taking of both medical and public health degrees the future alone will show.

In any case it seems clear that a school of public health is less a parent stem from which its various specialties branch off than a finishing place at which men trained in diverse fundamental disciplines may come to gain a broader knowledge of the place in this field of their own specialty. For certain types of workers specified above such subsequent extensive education is not essential, since the specialized nature of their work makes it possible for them to render adequate service without passing beyond the limits of their chosen field. In this group, requiring merely the specialized training which they may receive in the ordinary college or university, I should place the nutrition expert, the expert in physical training, the dentist, the psychologist, the entomologist, and the lawyer, while the sanitary engineer, unless he desires to become an administrator, needs nothing more than he can obtain in the broadest and best existing schools of engineering. Most of the other types of workers after completing their fundamental course should receive in a school of public health at least one year of education which will fit them to apply the viewpoint they have acquired to the broader problems of sanitation. The physician who is to play a large part in the public health campaign must be more than a physician. The nurse who is to be a satisfactory public health nurse must take the eight months' graduate course in public health nursing now provided in so many American cities. The bacteriologist must add to the bacteriological training he receives in college special advanced work in bacteriology and a broad vision of the other disciplines that contribute to the art of public health. The chemist is a similar case. The social worker and the statistician, in addition to a broad college training in the social or statistical sciences, should spend at least a year in learning what the public health movement is about; and the public health propagandist, in addition to an ordinary college training, should also devote at least one academic year to the study of the problems he is to teach. It is for this purpose—of converting the physician, the nurse, the bacteriologist, the social worker, the statistician into a public health physician, a public health nurse, a public health bacteriologist, a public health social worker, and a public health statistician—that the certificate in public health has been created, including, as it does in most of our leading universities, fundamental courses in the principles of public health and sanitary engineering, in public health bacteriology, and in vital statistics, so as to give a broad conspectus of the entire field and permit additional specialization along the particular line which the student may desire to pursue.

For the advanced worker, and the teacher, in any of these specialties such as sanitary bacteriology, sanitary chemistry, vital statistics, and the like, the ordinary degree of doctor of philosophy must be open, and for the administrator our more conservative universities reserve the degree of doctor of public health, representing the essential equivalent of two years of postgraduate training following the medical degree, or correlated with the medical degree in a combined 5-year course.

I am inclined to believe that the experience of the past 10 years has not only clarified our thought in regard to the field of public health and the kind of workers needed to cultivate it, but that it has given us in the C. P. H. (or its equivalent, the M. S. or M. A. in public health), in the Ph. D. in public health, and the doctorate in public health essentially the educational machinery needed for the solution of our problem. Provision for the training of sanitary inspectors has as yet, however, found no place at all in our educational scheme, and this is a problem to which very serious consideration must be given in the coming years. In England it has been admirably carried on by institutions like the Royal Sanitary Institute, and it may well be that this type of training can best be organized outside the walls of the university and by special organizations created for the purpose.

As Doctor Rosenau stated this morning, it is simply a question of getting the right people to come in. We are not concerned with quantity—the quantity is all right. But the quality is not all right. Our chief problem is to attract the right type of young men and women as they graduate from our medical schools into this field of public health. This is a problem that must be worked out if our educational machinery is to be complete.

WHAT KIND OF MEN AND WOMEN WILL BE NEEDED IN THE LOCAL HEALTH UNIT IN BRINGING PUBLIC HEALTH TO THE "ULTIMATE CONSUMER"?

WALTER H. BROWN, M. D., *National Child Health Council.*

Had I been present at the meeting this morning and listened to the discussion of what it was necessary to know and to understand and to be skilled in before I had the temerity to accept the responsibility for the direction of a local health unit, I assure you that my courage would have failed me and I should never have been a local health officer. And yet I come to you this afternoon to make a statement that I believe is worthy of your consideration, namely, that the type of individual that we need in the field of public health at this moment is the general practitioner of public health. [Applause.] I believe this, notwithstanding the fact that I look forward with great enthusiasm to the time when each one of these men who must deliver to the ultimate consumer the things that we want delivered to him shall have all of this skill and all of these qualities and all of these specialities. But, pending that time, my friends, we must produce a group of men and women in this country who will do what the general practitioner of medicine has done—ordinary everyday tasks, imperfectly perhaps in the beginning, until such time as we set up machinery, recruit personnel, and properly train it for giving to all the United States the specialized services every one of us desires to see for our country.

I believe that it will be necessary for us, therefore, to improve constantly the character and efficiency of the work of our local health units. Whether we like it or not, we have not been able to give to public health, in the minds of the average person and the people who control our governmental functions, the relative importance which its place justifies. I do not fail to recognize that we have made immense strides. Whether we have accomplished this by means of propaganda or otherwise is not for me to discuss. Nevertheless, it has been accomplished. We have made progress. But to-day we know that public health does not occupy its proper relative position. The assumption and the holding of this position depends upon a well-informed public which appreciates the value of the service being rendered. In the last analysis, our progress in public health varies directly with the efficiency of the local health units.

Now, I do not think that it is necessary for us to argue this afternoon what the most intelligent of our people now realize, that no modern community can afford to be without adequate machinery for the prevention of disease. Promotion of public health actually is possible; we believe this thing is practical. But we must translate our knowledge into machinery; machinery to make the available knowledge effective. This machinery includes a health unit that has adequate powers, sufficient funds, and a trained personnel.

It would be beyond the scope of what my subject includes to discuss with you the details of an ideal health service for cities and counties. They must necessarily vary in different parts of the country and with varying local conditions. However, it is well to say that we do have a well-accepted set of standards of the fundamental services that are required for the protection of the public health. These standards have been recorded in the numerous surveys of health administration by members of the United States Public Health Service; in the reports of city health officers, and, for the county field, in the "Transactions of the Conference on County Health Work" held at Johns Hopkins School of Hygiene and Public Health in December, 1920, under the auspices of the International Board. In other words, the pressing problem in the field of public health is not one of production nor of program but of selling and distribution.

The most important single factor required to secure adequate health service for a local community is a competent sanitarian. This particular health worker occupies a most important place in our present plan of health administration. He is the selling and distributing agent. Through him must be delivered to the "ultimate consumer" the accumulated results of research and experience. Consequently the success of our efforts to improve the public health will be largely conditioned upon the character, training, and experience of this group of individuals.

The type of sanitarian needed for this task is a "general practitioner" of public health. He should be well grounded in the basic medical sciences and possess a knowledge of the elements of medicine, surgery, and pediatrics. To this must be added a sound training in hygiene, sanitation, preventive medicine, vital statistics, and public-health administration. In addition he needs a speaking acquaintance with all of the specialties of public health. This is his technical equipment.

We have many courses of training which can furnish our sanitarian with all of this equipment. We have not provided, however, a way for him to acquire skill in "social engineering." By this I mean an ability to use all of the forces in the field of health, both official and nonofficial. Now it seems almost tragic that the public-health movement has not been able to utilize more fully the resources of the great volunteer agencies such as the Red Cross, National Tuberculosis Association, and American Child Hygiene Association. They represent a great potential force for securing support for the work of the sanitarian. They also help to translate into permanent governmental machinery the newer ideas for the preservation of health.

The successful leader in public health must by his presence and personality be able to influence people. Armed with a knowledge of social and political organization, he must be capable of meeting Government officials and the general public. This necessitates the ability to speak effectively and to exercise public-health diplomacy. Few trained sanitarians fail on account of a lack of technical knowledge; many fail for the lack of the qualities of leadership. It is true that some of these skills and qualities are difficult to impart, but our schools for training sanitarians should make a serious attempt to solve the problem. I am convinced that much can be accomplished by providing in our public-health courses a training in social engineering and the conscious stimulation of the powers of leadership in the student.

The details of training courses for sanitarians will be presented at a future session of this conference. I believe it is pertinent at this time to suggest that in addition to the training already mentioned provision should be made for actual "clinical" experience in order to produce the proper type of local health official. I believe that it is feasible to develop a practical method whereby selected State, city, and county health departments may become actual training centers just as our great hospitals have become an essential part of our plan of medical education.

To summarize, the future progress in public health demands that the character and efficiency of the health units be improved and that public health be given its proper relative place among governmental functions. In order to accomplish this we must sell and deliver to the "ultimate consumer" the results of scientific research and practical experience. To this end we must produce a type of trained sanitarian who is a "general practitioner" with a speaking acquaintance with all of the specialties; has had "clinical experience"; is an effective speaker; is a social engineer; and who, in the words of Professor Whipple, "can understand the relation between community health and community environment; who is a sanitary statesman."

Now this is a difficult set of specifications for the ordinary health officer. But I believe that if we can remove the health officer from the field of partisan politics, giving him a reasonable tenure of office based upon efficiency, we can give to him a position that will enable him to meet his obligations as a man. I have absolute faith in the fact that if this message is presented to the young men and women of our universities and medical schools, out of that group will come a high type of idealists that will enable us to produce this new kind of statesmen.

WHAT KIND OF MEN WILL BE NEEDED IN THE FUTURE DEPARTMENT OF HEALTH, ESPECIALLY FOR THE LARGER ADMINISTRATIVE TASKS?

Dr. A. J. McLaughlin, *Assistant Surgeon General, United States Public Health Service.*

The evolution of health departments and the widening of their scope of activity has necessitated the development of specialists in sanitary engineering, epidemiology, bacteriology, vital statistics, public-health education, and the newer aspects of public health. The great need for these highly specialized workers is now almost universally recognized. The question arises naturally, Do these specialists need the complete training of the health officer? I should answer that question by saying that if the specialist aspires to the higher administrative positions he should have the complete training of a health officer.

While specialists in various phases of public health work, bacteriology, epidemiology, vital statistics, sanitary engineering, or any other specialty may have this special training added to the basic training of the B. S. degree, it is certain that the public health administrator of the future should be a general practitioner of public health as well as a specialist. He will need a medical basis for his training, and added to this he must have a general knowledge of every phase of health work—epidemiology, vital statistics, bacteriology, sanitary engineering; child, mental, and industrial hygiene; and public health administration, including business methods and public health education.

This means that a young man with perhaps an arts or science degree who acquires a special knowledge of vital statistics, bacteriology, or any other single specialty without a basic medical training must be satisfied to be a useful cog in a machine of his specialty, without ambition or aspiration for the larger administrative positions. This does not mean that the basic medical training referred to should be the conventional four-year course now given in our medical colleges leading to the degree M. D. It is quite certain that this course does not contain all the essentials. Nor does it give sufficient accent to those fundamentals of public health which happen to be included. It is equally certain that the ordinary curriculum of a medical college as applied to the prospective health officer contains subjects which could be either eliminated or the number of hours devoted to them greatly curtailed. Modification of existing curricula to meet public health requirements is necessary. The "Y" plan suggested by the late Professor Sedgwick has much to recommend it, and it will be explained and discussed in detail by other speakers. Educators should frankly inform students of the possibilities, and should particularly accentuate the limitations of partial, highly specialized public-health training.

The public-health administrator of the future must be less of a policeman and more of a statesman than the health officer of the past. The old health officer type was usually a practicing physician who upon assuming his new position was most impressed by the very large police powers which came to him with the position. He considered it his duty to confine his activity to enforcing law and regulation and clamoring for more law and regulation.

Most health officers of experience now know that the best results can be obtained voluntarily by the lever of public opinion and that a law or regulation which is not supported by popular opinion will be ineffective. The wise health officer will regard police power as similar to the foundation of a building. We like to know that it is adequate and strong, but once satisfied of this, we may almost forget it and devote our energies to securing the proper type of superstructure. We also realize that the limits of our activity under law and ordinance have been reached and that significant reduction in morbidity or mortality will depend upon voluntary cooperation rather than compulsion.

The public-health administrator should be a business man and a statesman. Too often you hear the trite calumny that doctors are poor business men. This popular impression extends to the medical health officer. Training in health administration should include thorough courses in business methods, cost accounting, and budgetary systems.

He must not only include in his program of work all the newer aspects of public health which have developed in recent years, but he must have the vision to plan and take up promptly new lines of attack on public health problems. This does not mean that all such work must be carried out in the health department itself. Some of it may well be carried out by other departments of government cooperating with the health department. He must have the wisdom and the courage to relegate to other departments of government indirect health activities which do not properly belong in the health department, retaining through cooperation a consultant relation to such work.

He should possess the qualifications of a statesman because he will find it necessary to control and utilize all sorts of unofficial, voluntary health agencies and spontaneous popular movements. The ideal health administrator will attempt to make every citizen of the State feel that he is a partner in the enterprise of public health and an integral part of the health machine.

How can a man acquire the qualifications necessary for a successful health administrator? Provided he has certain fundamental inherent qualities, he may acquire the necessary training in two ways—by experience alone, or by training in a school of public health plus experience. The first, by experience alone, is a long, hard road—hard on the student and hard on the public, who must suffer for his mistakes. The second is the ideal method, a proper training in a public-health school with a proper curriculum for the purpose, supplemented by practical experience during his course and after his graduation.

Our ideal health administrators of the future should be men of such caliber that they will rank in statesmanship with the relatively small number of really great leaders in each State. Men of this type have been developed in State and city administration, and their leadership and prestige is such that they secure teamwork and compliance with any given program with the maximum of prompt results and the minimum of friction. We must find a way of producing in greater numbers and much more quickly the type of health administrator who has become a national figure through the slow school of experience.

There is a very general impression that the administrator is successful because of what is commonly called personality. The opinion is equally prevalent that this co-called personality is inborn and can not be acquired. I do not subscribe to this view. Many of the qualities which are grouped under the rather indefinite label "personality" can be taught. Men are often brusque from imitation of a superior who seems to be a successful health officer. Such a health officer considers his brusque, uncompromising attitude toward the public as an evidence of strength of character when it is really nothing but a pose. The young student of public health working under such a chief is very likely to imitate his example. Conversely, he can be taught to imitate a very different type quite as easily. Character is molded largely by our imitative faculty. Many faults of character can be curbed, controlled, or eliminated and good qualities developed by taking advantage of the imitative faculty of the young and furnishing in our teaching the proper models for imitation.

To give the training necessary to produce the type of public health administrator indicated above will necessitate special public health schools or very radical changes in the curricula of our existing schools. In addition to the many special subjects which must be taught, the greatest stress must be placed on teaching and demonstrating public health administration. This is a subject without a textbook and the number of teachers with practical experience and the other necessary qualifications is limited. Such men must be added to the faculty of any institution which expects to graduate men qualified as public-health administrators.

To summarize, I hope I have made it clear that the successful health administrator of the future, in addition to his professional training, must be a business man and a statesman, and that proficiency in these two phases can be acquired by proper courses of training in our schools. The qualities of a business man will inspire confidence in the legislative body which makes the appropriations, and the statesmanlike qualities will enable him to utilize to the best advantage all the official, unofficial, and voluntary agencies engaged in public health activity.

WHAT KIND OF MEN WILL BE NEEDED FOR RESEARCH?

Dr. A. M. Stimson, *Surgeon, Assistant Director Hygienic Laboratory, United States Public Health Service.*

We have talked a great deal here about education and have taken up two out of three possible features. We have spoken of the person who is to be taught and of the person who is to teach. The next thing is naturally what are we going to teach. If we teach only what we know at the present time we will not succeed in eradicating disease at anything like the rate at which we would like to see it eradicated. We have got to have more information all the time. If you analyze public-health practice at the present time, you will find that there are a great many diseases which we attempt to prevent by methods which would not stand very strict analysis. They are not really fundamentally scientific. Many of the methods which are in common usage are really rule of thumb methods. We must have more accurate means at our disposal and the only way we can get these means is by research.

On the entire program the word research occurs but once. That is probably the proper proportion, because already we have so much material at our disposal to be taught to prospective health officers that we can spend quite a few years in using that up before we need the new material that is to come forward. The information is considerably ahead of what the public has absorbed or applied. There is no doubt about that. Still, I do not like to be the sole representative on the program of this particular branch of the subject, and I hope that those who discuss later on will expand and improve upon what I have to say.

Professor Winslow has given us a classification of health activities and health workers which I am perfectly willing to accept and I think it probably superior to any I could evolve. But from the standpoint of research I have attempted to group those who are to engage in research in coming years under three general headings. There are not any good names which are exactly descriptive of these groups, but for practical purposes and for the purposes of this meeting I suggest the term epidemiologist for the first group. By that I mean those who study the mass phenomena of disease. They use special methods which are only at the present time being formulated. They use statistical methods to a large extent; they deal with sociological and economic phenomena and their data reach all the way from the details of pathology up to the very broad considerations of sociology.

The second group of research workers I will describe as the clinical investigators, and by that I mean those persons who in the presence of the sick person study disease and try to learn the methods of its development and of its control.

The third group I would suggest are the laboratory investigators. I do not mean that the laboratory investigators are merely those who work in the laboratory, but I mean those who employ the methods of experimental research under laboratory conditions, whether it be in the laboratory or as applied to some problem which is to be done outside of the laboratory, but is essentially an experimental research.

Now, the tentative program which was handed me asked for a discussion of the qualities of research workers, and of the ways in which medical schools and schools of public health may develop men with these qualities. *What qualities will be needed in coming research workers?* As I see it, they will need those qualities which have characterized successful research workers in the past. I am not a psychologist and I can not define these qualities in the terms which ought to be used. But in ordinary parlance the qualities needed in a research worker are: (1) A passion for that sort of knowledge which can be experimentally verified; (2) an imagination which is sufficient to frame fruitful hypotheses, not bizarre, crazy hypotheses which will waste lots of time, but a controlled imagination which seeks for and formulates hypotheses which are likely to be fruitful; (3) inventiveness, a sufficient inventiveness to think of ways of working out those problems which they have framed; (4) an industry which is not to be turned aside by failure; (5) the quality of scientific honesty, which is probably the rarest of all the qualities which I have enumerated here. It is a frame of mind which is not satisfied with half truths even if they are of immediate practical use and which places the ultimate truth far above any consideration of personal advantage or of what is immediately desirable.

Now, these are the qualities of research workers which have led to success in the past. I think there is another one which is unquestionably demanded and that is the spirit of generous cooperation with other workers in similar lines. In the past we have had great geniuses who have sprung up and single handed have solved great problems and given us methods which have enabled us to accomplish a great deal. But in the future we can not expect very much of this. The research worker of the future must work in cooperation with other workers. Only by focusing the efforts of men who look upon the same problems from different angles are we to expect great advances in the future. Now and then we will have a great genius who will do things all by himself, but if we are going to organize work of this kind we must bring together men who work upon the same problem from different angles and are willing to cooperate.

Now, as to the training which these groups will need: The epidemiologist, I think, should have a broad training in general pathology. He need not necessarily have a full medical course, but he should have enough knowledge of general pathology so that the essential features of any disease which he is to investigate will be apparent to him, and he will not fall into the serious errors which those who have no training in pathology are sure to make. Again, as we look at this in the broad we find that social conditions and economic conditions are at the basis of very many of our problems. Consequently the epidemiologists (or men in this group) should have training in economics and sociology, and lastly they should have training in statistical methods.

Now, the clinical investigators: It would seem that the ordinary medical course ought to suffice to produce clinical investigators. As a matter of fact it does not seem to work out that way. Granted a man with all the natural qualities I have mentioned for research workers, it is to be doubted whether the ordinary medical course fosters and cherishes those qualities to such an extent that when a man comes out at the other end of the horn he is still potentially a research worker. This may be due merely to the immense bulk of actual detail information that has to be learned during the medical course. On the other hand, is it not possible that the method of teaching is such that it fails to develop those qualities which I have mentioned as belonging to research workers?

Now as to laboratory investigators: It is not essential that they should have gone to a medical school or to a public-health school. We must not think of research connected with public health as being particularly medical. Quite as much may come to us from laboratories or from workers who have nothing to do with medicine. The fundamental sciences of physics, chemistry, and biology will recruit fully as many valuable workers as the medical school or the public health school. It is the function of those who wish to develop and get the most out of research workers to bring together these men who have studied along different lines upon the particular problem upon which we are working and in that way solve it.

Ways by which medical schools and schools of public health may develop men with the needed qualities: The question can not fairly be discussed without entering the realm of pedagogy in which competence may justly be questioned. The user may know exactly what kind of material he needs without seeing clearly how the producer is to furnish it. He can only offer suggestions which may or may not prove practicable.

What are needed are men whose peculiar natural qualifications have been cherished and developed during the time when they have been accumulating the specific information essential in their subsequent work.

It would appear therefore that education should develop the imaginative, inventive, and reasoning qualities at the same time that it feeds the memory with ascertained facts.

The mass of facts to be assimilated in the medical course is enormous, and yet their mastery is probably essential to the production of the qualified practitioner. It is a question, however, whether the so-called medical specialities could not with profit be reserved largely for postgraduate study, thus relieving the pressure of the medical course and making possible the more general employment of the inductive as opposed to the didactic method of teaching. It is believed, moreover, that more insistence should be placed upon a thorough grounding in the primary physical sciences as an entrance requirement for the medical school.

The medical schools, however, will contribute in large part to only one of the groups of investigators—the clinical group.

The school of public health is a comparatively recent development, which offers great promise of ultimately providing the kind of men who will be needed in some of the departments of public-health research. They already include the study of certain essential medical subjects. In so far as the imparting of information is concerned, an extension of the courses to include certain sociological subjects and an intensification along certain laboratory lines would apparently suffice for the production of competent workers in the epidemiologist and laboratory investigator groups respectively. But this is only to be hoped for provided the teaching is such as to conserve and develop the native qualities which have been described.

The medical schools and the public health schools can not hope to do more than prepare men for some of the departments of research which will be required, and indeed will perhaps play no essential part in the training of certain specialists. These men, fired with the desire for excellence in some special line of study, will continue to select courses at different institutions which progressively contribute to reaching the goal which they have chosen. It is to be hoped that they will early discover that in order to get the most out of themselves, to contribute the maximum to the cause, it will be necessary for them at least to understand the aims of others who approach the same problems from different angles, and to subdue their individual aspirations to the extent of generous cooperation.

DISCUSSION.

Dr. Vernon Kellogg:

I am not competent to say anything about the special relations of the public-health workers to research, so I shall give my moment to a word or two about research in its more general relations.

The goal of our progress, of our human social evolution, can be defined in certain terms determined by ideals which come from our racial consciousness. That may seen rather indefinite, but actually I think all of us will agree that most human beings have a common consciousness of certain ideals for the future of the human race—what it shall become, what it shall do. But idealistic as our aims may be, we must be realistic in our methods of achieving these aims. To satisfy these conditions we must have scientific knowledge, which is an accumulation of facts, and an organization of these facts so that they may be effectively used.

It has been my privilege within the last few months, as your chairman suggested, to see at first hand the horrible scenes of the Russian catastrophe. Those scenes are brought about largely because of lack of scientific knowledge. The rulers of Soviet Russia lack knowledge. It is not simply that there is a lack of food. There is lack of everything to help care for the people in the interior of Russia. Such lack of sanitary conditions as exists there is hardly imaginable to us over here.

Scientific knowledge, then, we must have if we are to realize these ideals, and if we are to have scientific knowledge we must have research. Research is the special privilege of genius, but it is open also to a great many of the well-meaning persons interested in human progress. Any man of good intelligence and of good training can venture to try to find out new things in science, and that is all that research is.

The new field of the public health—what an extensive field for a man looking for new knowledge! And what an opportunity for a beneficent application of this new knowledge! You have before you an opportunity to do something for the human race that many men and women a little older did not have, even with all the good will in the world. They did not have the opportunity that you have because there was less in their time of the accumulation of scientific knowledge which now exists and can be used in benefiting human health and strength.

And so as the representative of an institution that is primarily interested in research I wish you Godspeed in the accomplishment of immediate good work by making use of what is known and by pushing forward beyond the horizon into new regions of knowledge which will make it possible for you to do more good deeds in the future.

Dr. William H. Park:

I did not even know that Doctor Vaughan knew I was here, and was having a very enjoyable time listening to others. I was naturally, as a laboratory man, much interested in Doctor Stimson's talk and I simply felt that every word he said was what I should like to have said. When I entered into public health work it was through the suggestion of Doctor Biggs and I learned from him what was brought out by Doctor Stimson, that in the public health laboratory we have to keep thinking of those problems which might give us some definite information. I remember at the very first, before I had had any experience, we wondered whether the problems would hold out. As time went on, of course, we found that the problems increased.

I liked very much Doctor Stimson's suggestion of scientific honesty. It is so easy in laboratory work with just a little bit done to think that we see the future and can already publish some very valuable results. It is very hard to wait until these results have been added to and added to and to be sure we have something which is really an advance in public health and not something which is one sided and to which objections may come up which make it of no use.

Doctor Biggs has brought up, although I do not agree with him, that public health laboratories are the most important functions of a public health administration. The laboratories have certain sane, useful functions. They bring laboratory methods into public health work and add now and then some new points. The laboratory brings the medical profession in touch with the health authorities. If the physician is receiving calls from the laboratory a cooperative spirit is developed between the health authorities and physicians which could probably be obtained in no other way.

IV. HOW MAY MORE AND BETTER SANITARIANS BE RECRUITED?

REASONS GIVEN BY MEDICAL STUDENTS FOR NOT ENTERING SCHOOLS OF PUBLIC HEALTH AND PUBLIC HEALTH WORK.

EDWIN O. JORDAN, Ph. D., *Professor of Bacteriology, University of Chicago.*

Brief questionnaires were distributed to the medical students in two universities where public health schools are already established (Harvard and Johns Hopkins), and in two where no definitely organized public health schools exist at present (California and Chicago). The questions were designed to bring out the student's reasons for entering a medical school rather than a school of public health and the reasons, if any, why public health work seemed unattractive. Four hundred and sixty-one replies were received. One hundred and three students, or between one-fourth and one-fifth of the whole number, stated that they had at some time considered more or less seriously taking up public health work. A few of these (Chicago 3, California 5) asserted that they were studying medicine because a public health school was not available, but a much larger number (32) declared that they considered a preliminary medical training essential to the proper prosecution of public health work.

The 358 medical students who stated that they had never been attracted by and had not seriously considered entering public health work gave as their reasons:

(A) Insufficient knowledge of the field (23 per cent).
(B) Desire for personal contact with patients (18 per cent).
(C) Politics (15 per cent).
(D) Inadequate remuneration (9 per cent).
(E) Lack of independence (9 per cent).

Of the 103 students who stated that they had at some time considered entering public-health work, about one-third (32) were still undecided; 4 or 5 were still intending to take up public-health work, but all agreed that a medical training or at all events a medical degree was essential. The other two-thirds had abandoned all intention of a public health career very largely for the reasons already cited. Politics (C) was a determining or important factor in 28 per cent, inadequate remuneration (D) in 23 per cent, lack of independence (E) in 17, lack of personal contact (B) in 14. Other difficulties or objections mentioned were the limited field of public health, the large amount of routine work, the restrictions placed on personal initiative, the narrow choice of location or the entire lack of choice in the national service, and (in California and Chicago) the lack of suitable opportunities for study.

Representative answers from both groups will illustrate the students' point of view.

(A) Insufficient knowledge of the field (23 per cent).

"Public health is new and only within recent years has there been much discussion of it. As yet the public has not grasped its importance. I have decided on medicine or surgery because of the uncertainty as to just what public health work is and what it shall include in its scope."

"Schools of public health are new and public health work is comparatively unknown to most persons. This is certainly an important reason why others, as well as I, have not undertaken to prepare themselves for this work."

"I have never thought of men being trained especially for the work, but think medical students should be furnished with information about the matter."

"I have known nothing about public health work. I should have considered it, probably seriously, if I had known anything about it and might have entered it, if it had been brought to my attention. I never heard of a public health school, although I am a B. A. of Yale and an M. A. of Columbia."

"I have never considered the matter of public-health work and do not know enough about it to comment on the desirability or undesirability of said work. Would welcome information on the matter."

"I have never heard of public health as a profession in itself."

"I have no information about public-health work that would bring the matter up for discussion."

"There is no well-recognized school of public health in the United States." (Twenty-eight students in the Universities of Chicago and California declared that they had never heard of any school devoted to public health.)

(B) Desire for personal contact with patients (18 per cent).

"Medicine—general practice—gives the most opportunity to enjoy personality and gratify psychological curiosity."

"I prefer the treatment of and contact with individuals to work with large groups or whole communities. I find the application of anatomy, physiology, and pathology in study and treatment of disease in individuals much more interesting than study of epidemiology and public health work in general."

"Personal contact with patients appeals more than dealing with the community as a whole, though the opportunity for service may be as great in one as in the other."

(C) Politics (15 per cent).

"Public health work is in the hands of politicians rather than medical men who are actuated by idealistic motives."

"I do not wish to be dependent on political pull for a living."

"Under the present régime remuneration and position to be obtained depend not on ability, but upon the patronage of a 'higher up.'"

"As politics are at present conducted, the uncertainty of one's position as a public official or employee is very great. If this uncertainty is remedied in the future, public health work will appeal to the medical student much more than at present."

"Promotion is too often the result of 'pull' rather than merit."

"Public health work as I have seen it seemed to be political rather than scientific."

"Public welfare and health are indeed ideals, but depending on politicians for a job is another matter."

"Politics play too large a part not only in obtaining jobs, but in prosecuting any project."

"I consider preventive medicine a most desirable field. The fact that it is tied up with politics makes it undesirable as far as I am concerned."

(D) Inadequate remuneration (9 per cent).

"The remuneration for a man who has spent nine or more years in preparation is inadequate in public health."

"Discouraging expenditure of money and time necessary for adequate training in public health."

"While the financial aspect has never been a factor in prompting me to study medicine, I do not believe that the remuneration in public-health work is, in most instances, adequate when the preparation and work is considered."

"The compensation in medical practice bears some relation to your ability."

"Only persons financially independent can think of making the outlay in time and money necessary for a high-class medical training, add to that training in public health work and then receive the average salary that is paid one so trained."

"The remuneration is not sufficient to repay men who have had to spend the time and money to obtain a bachelor's degree (B. S. or A. B.) previous to their entry into medical school and the expenses of such a school as Johns Hopkins Medical School."

(E) Lack of independence (9 per cent).

"One's success in clinical work depends more on one's work than is the case in public health work; that is, one obtains more immediate returns in clinical work, and more proportional to one's efforts."

"It is my impression that a diplomat or a politician would succeed better than a person who perhaps is better fitted actually, but may possibly lack personality."

"There is always a suspicion of dulling the initiative in any Government position—saw too many Regular Army medical men during the war."

"There is no swivel chair dictation (in medical practice)."

"I prefer independence rather than the hierarchy of the Public Health Service; in other words, I endured the life (as private) in the Army as a war-time duty and would not look forward to a lifetime of always recognizing a superior officer and being forced to "drive" subordinates. Note that the above reasons are all based on personal preference, i. e., I am not the type of person who would like public health work. I think that the Public Health Service offers (as far as my slight knowledge of it goes) an ideal career for the right type of man."

"I do not wish to work for a salary."

Closely connected with such objections is the frequently expressed dislike for routine, clerical, and administrative work. Army experiences are often referred to.

"Any type of close organization gives a chance for subordinates—which savors of the Army."

"The odiousness of rank."

"Experience in Army makes me feel there are many small annoyances in working for a large organization, e. g., red tape, etc."

"Would not consider any civil service."

"After being in the Army, I didn't want to work for the Government."

"I feel public health work is too much like the Army."

A good many students have expressed their belief that public health work is simply a "branch of medicine," a part of the duty of the practicing physician. There is an obvious tinge of resentment in some of the answers.

"Because I consider medicine a well-established and recognized profession from which one can to the best advantage promote and aid the newer and less well-established work of public health. I consider public health fully as much the concern of the doctors, educators, social service workers, ministers, and public officials as any other of their professional or social duties."

"I have little or no interest in the merely technical or superficial types of public health work which a man can engage in without a modern thorough medical training."

"Because I want to make my contribution to personal and public health from the standpoint and in the capacity of an active practitioner."

"My interest in laboratory work and public education is collateral to my interest in the practice of the healing art. I believe that, for myself at least, a first-hand knowledge of disease and its cause and treatment is the best starting point for work in disease prevention."

"Public health is at present a branch science of medicine. The medical student receives nearly all of the training that a public health student receives and much more. In an ideal State the medical man should be a public official and public health workers should be medical men who have specialized in public health work."

"My impression has been that public health work was a part of a doctor's profession. Therefore I felt that public health work would just be a part of my work."

"I believe a good doctor can do as much for the benefit of public health in an indirect manner as he could in actual public health work."

"The medical man can serve his fellow men directly, at any place and at any time, without the aid of extraneous help."

"I have a pretty clear idea as to the nature of services I shall be expected to render in medicine, and I have always thought of public health posts as being filled by persons chosen among successful practicing physicians."

"An M. D. with a little special training can adequately fit himself for public health work if he does not wish to practice medicine. The activities of a C. P. H. or a D. P. H. or a Ph. D. are limited to restricted fields and their knowledge of disease is insufficient."

"Medicine offers an opportunity to do public health work and at the same time earn a living."

The esteem in which public health work and workers are held by some medical students is not of the highest.

"There is no school of public health, as such, that approaches a Class "A" medical school in quality of technical training."

"Public health work in schools is not given with the same serious elaborateness as medical work is given."

"Never heard of a school of public health that I would be willing to graduate from."

"The medical profession does not itself take public health and preventive medicine seriously. This is just as true at Harvard as elsewhere."

"I know very little about public health work. I have been prejudiced against it, however, due to the fact that in the very few cases which I have observed the men engaged in the work are not good medical men. These cases have been in smaller cities and towns and the salaries have been low which has probably been the reason why the better men in these communities have not taken it up."

"Have looked upon public health work as something which I might take up if I failed in my ambition, as I have known others to do."

"The type of men preparing for this profession."

"No physician with the ability to practice medicine, it seems to me, would want to go into public health, where the services can be competently performed by any good bacteriologist or laboratory technician, who with the help of a small office force can get out a volume of vital statistics per annum."

"The service contains men who are there because they are unable to earn a livelihood outside, rather than for the love of the work."

A number of students explained that they had originally intended to take up public health work but had become interested in medicine.

"I was graduated in 1916 with the degree of S. B. in biology and public health, and entered medical school with the intention of following that phase of medicine. Either medicine or surgery seems now more attractive than public health work, because they offer very interesting careers, doing a great deal of good and giving a more suitable financial return for the investment of time spent in training than does public-health work. This preference is definite in spite of a decided liking for, and some training and experience in, administrative and educative work, and a keen appreciation of public health ideals. The financial income is usually small. Many positions depend upon political preferment. The assignments in the Government service are often arbitrary and may be disagreeable. Independent action is curtailed. The commanding officer, if the Public Health Service is like the Army, may be a crank, an autocrat, or a man selfish and without consideration for deserts of his subordinates. The opportunity for educating children may be less than one would desire."

"I intended to go into bacteriology, but Doctor ——— advised an M. D. first. I took his advice, but now no longer care to specialize in bacteriology."

There is little difference in the nature of the replies from the four institutions. Students at Harvard have laid perhaps more stress on lack of independence, dislike of administrative or laboratory work, and inadequate remuneration; at Johns Hopkins on the baleful influence of politics; and at California and Chicago on their belief that public health work is nothing but a branch of medicine and should be kept to the practicing physician.

First-year medical students, as might be espected, express a somewhat more general interest in public health work than students in the later years; otherwise there is not much difference except that students in the upper classes use a more emphatic or a more scornful tone in their rejection of a public health career.

Some of the manifest conclusions from the reading of the 461 questionnaires are (1) that many medical students, particularly those distant from the neighborhood of public health schools, are insufficiently informed concerning the nature and opportunities of public health work, and (2) that those students who are at all attracted by public health work are mainly deterred from entering the field by fear of political interference, inadequate remuneration, and distasteful living and working conditions.

HOW CAN THE CAREER OF THE SANITARIAN BE MADE MORE ATTRACTIVE?

Dr. John A. Ferrell, *Director for the United States, International Health Board.*

The future of public health in the United States will be merely a reflection of the combined personalities and abilities of the men and women who engage in the work. If the ranks of the workers are recruited with persons of the right type in sufficient numbers the future welfare of the service on an enlarged and more effective basis will be assured. Persons who can bring the greatest degree of success to the cause while recognizing the exceptional opportunities the field offers for rendering public service will hesitate nevertheless to enter it as a vocation unless the conditions under which they are to serve are made reasonably attractive in comparison with those existing in other professional fields. They will inquire if the public may be expected to regard efficient health officers as professional rather than political appointees; if their activities and tenure of office will be protected from harmful political influences; if their compensation—present and prospective—will be adequate; if the growth of the work may be expected to provide employment for sanitarians in increasing numbers; if opportunities will exist for those who are especially qualified to achieve distinction in administrative, investigative, educational or other branches of the service.

The scientists, educators, and executives who are here for the purpose of formulating a program for the advancement of public health in this country should consider especially the question: What can be done to make the career of the health officer more attractive? His working conditions should be established on a basis which will appeal to those best qualified to successfully develop and apply public-health measures.

The definite steps which suggest themselves all involve the education of the public, of our legislative bodies, and of many of the teaching and practicing members of the medical profession. I shall attempt to discuss a few phases of the educational work which should receive attention.

1. *Preventive medicine should be recognized as a distinct profession.* This fact is now insisted upon by authorities in medical and public health education. Steps should be taken to make it common knowledge, and develop an understanding that the health officer, even if a physician, should have special training for his work.

Students in our medical schools have been taught much that is essential for the health officer to know. Unfortunately, as a rule they have been trained to view disease and disability only from the point of view of the individual patient, rather than from that of the community, and to render service after rather than before disease develops. Their training without consuming a great amount of additional time might have included the underlying principles of disease prevention and control from the standpoint of both the community and the individual and thus have prepared them to discharge more creditably the professional and civic responsibilities which they encounter on entering practice.

The physicians prepare practically all birth, death, and morbidity statistics that afford guidance to health authorities and serve as measuring rods of progress in the prevention of sickness and death. They are appointed to serve on boards of health, and communities look to them for counsel in public-health matters.

Moreover, physicians are frequently called upon to serve as health officers. In such cases, if the physician has failed to study diseases from the standpoint of prevention and the community's welfare, and is unfamiliar with elementary principles which the medical courses might have provided, he is unable to discharge his task creditably and the arrangement is detrimental to scientific medicine and to the cause of public health. Such a situation gives rise to confusion, controversy, a loss of public confidence, and the resultant developments which delay the progress of preventive medicine, and discourage young men and young women of the best type from selecting the work as a vocation.

The public is being educated to appreciate the virtues of preventive medicine. Many healthy individuals now go to their physicians for periodic examinations and advice with a view to keeping well. Moreover, the educated public may be depended upon to accord leadership in public-health activities where it belongs. Authorities in medical education are alive to the situation, and the more progressive medical schools are establishing creditable courses in hygiene and public health, so that the medical student in connection with his regular undergraduate studies will learn to give consideration when serving his patient to preventive as well as to curative measures, and keep in mind the best interests of his community.

Another gratifying development of recent years has been the establishment of institutions prepared to offer thorough instruction in all subjects upon which is founded the science of public health in its broader aspects. The courses offered include those subjects relating to public health which may be taught in the best medical, engineering, and other schools, and also other subjects, such as epidemiology, vital statistics, and public-health administration, that until recently were not taught in any school. The courses are organized and presented entirely from the standpoint of hygiene and preventive medicine.

The teachers and students in the undergraduate courses of medical schools would be stimulated to direct their interest more and more to thorough training in the elementary principles of hygiene and public health if the health authorities would take the steps necessary to have every licensing board give a real examination on public-health subjects. Provision might be made for having a trained sanitarian serve as a member of each licensing board. Moreover, candidates for public-health positions should be required to give evidence that they are fitted for the responsibilities they desire to assume.

These measures should be supplemented by the effective education of the public to understand that only trained sanitarians should be engaged as health officers. When appointments to such positions are limited to those who have had special training in schools of public health or in the school of experience—preferably both—the public will soon come to recognize that its protection from disease and preventable disability is a task for experts and it will be ready to support any legislation designed to make the field attractive to men and women of the highest grade.

2. *The people should be acquainted with the striking achievements of preventive medicine.* This may be accomplished, among other means, by courses in the public schools, through newspapers and popular magazines, and by the use of lectures, lantern slides, and moving-picture films. Emphasis in all this educational effort should be laid on the fact that the results were not obtained by haphazard methods, but because the underlying principles of disease control were understood by those in charge, each successive step being suggested by scientific reasoning.

Whenever concrete examples of striking accomplishment may be pointed to, no opportunity should be lost to drive the lesson home to the people. Facts and figures showing an actual reduction of sickness and death rates mean more to them than any amount of theorizing, and no pains should be spared to secure accurate records that will form the basis of such convincing demonstrations. Thus, to be able to say that in one town in Tennessee the cost of malaria in doctors' bills, medicine, and lost wages was $3,558 during 1919 as compared with only $165 in 1920, following the installation of anti-mosquito measures; that there was a reduction in the number of cases of dysentery from 498 to 58 following the inauguration of health work in Troup County, Ga.; or that typhoid fever declined from 147 cases in 1917 to 15 cases in 1920 as a result of health effort in Monroe County, Miss., is to lay before the people facts that they are keen to grasp and whose import they are quick to appreciate. It can then be pointed out that the demonstration made in similar units such as counties, townships, or the wards in cities can be applied equally effectively over almost the whole of a State or Nation, as has been done in North Carolina, for instance, where, in nine counties, the average deaths from typhoid fever per hundred thousand decreased from 35.3 to 7.8 following the carrying out of intensive health activities.

When the public is thoroughly informed as to the benefits attending the successful application of preventive medicine, and realizes the extent of the training that is requisite for such application, there is no question but that it will insist upon conditions of public-health service being made at least as attractive as in corresponding professions such as law, medicine, or engineering. It will realize that the work will attract the best type of young men and young women when, and only when, the field is free from harmful political influence, and when there is reasonable prospect that appointment, compensation, and tenure will be based upon merit alone.

Although there has been rapid progress during recent years in establishing health work on a sound and attractive basis, much yet remains to be done. In this connection the developments in the field of education have suggestive value. In the colleges and universities of most States, and in most municipalities also, there are nonpartisan boards in charge of educational activities. These boards have a rotating membership, and to them is intrusted the task of filling important positions, consideration of policies, adjusting salary scales, and similar functions. If the members of the boards are selected because of ability and breadth of vision they are likely to be better qualified than are the rank and file of elective officers to choose competent executives and teachers.

With such a board at the helm there is less danger that the changing fortunes of political parties will cause competent workers to lose their positions or be neglected in the matter of promotion, recognition, and other features relating to the attractiveness of the vocation. Where corresponding boards have been organized and placed in charge of public-health administration, the work has been stabilized and the conditions under which sanitarians serve are much more satisfactory than in localities in which there is danger of wrecking the health machine every time a new administration assumes the reins of government.

3. *Health work should be made efficient.* In health work as in any other field, unless efficient service be rendered, it is not reasonable to expect that funds will continue to be supplied or that satisfactory conditions of service will continue to be maintained. To secure these ends the taxpayers must be convinced that every dollar they set aside for health work is being wisely and effectively expended in programs that yield a satisfactory return.

If the health officer is to command the support of professional men (particularly members of the medical profession), his scientific procedure must be sound; if business men are to respect him his efforts must be productive and his methods neither wasteful nor extravagant. Where convincing demonstrations have been conducted, the public has shown a willingness to give the health officer generous backing in carrying out his policies.

4. *The opportunities for research and investigation should be multiplied.* To the exceptional student, endowed with qualities which characterize the pathfinder in various fields of knowledge, the attractiveness of a particular field as a career is proportionate to the possibilities existing for enlarging the horizon of knowledge by discoveries and the possibilities for increasing the effectiveness of existing methods of practical application.

Scientific medicine itself is comparatively new, and its application along preventive lines is even newer. Although significant progress has been made and our present knowledge is comprehensive, exceptional opportunities still exist for fruitful investigation.

Some of the public-health agencies are affording qualified students opportunities to engage in laboratory research and field investigations. Many health officers and students possess the personal and scientific qualifications essential for such work and would gladly engage in it if such a course were financially practicable for them. The cause of public health can be served most constructively if in such cases scholarships or fellowships are provided. A beginning has already been made in this direction, but the funds available to date are totally inadequate to meet the needs of the present situation.

Summary.—To summarize, the following are some of the steps which may if carried out make the career of public health more attractive:

1. By effective educational measures, bring the public at large to a full realization that preventive medicine is a distinct professional field, for which special and thorough training and experience are essential; and that at present our medical schools fail to supply all the training requisite for effective work in this field.

2. By means of convincing demonstrations and thorough education of the public, develop public-health service into a strictly professional vocation, free from harmful political influences, to the end that merit alone will regulate appointments, assignments, tenure, compensation, promotions, public recognition, old age and service disability retirement, and other factors that will tend to increase the attractiveness of careers in this field.

3. Increase the efficiency of public-health measures for which funds have been provided, and exhibit the results widely in a convincing manner, to the end that the public will insist upon the enlargement of its investment in this field, and demand, on a more generous compensation scale, the employment of increasing numbers of competent workers.

4. Multiply for qualified persons the opportunities to participate in broadening the horizon of our knowledge of preventive medicine and its effective application.

DISCUSSION.

Dr. Frank J. Goodnow:

I really do not know why I should be here to speak on this subject. I must confess I feel as though I had gotten into the wrong pew. I was educated as a lawyer and from the point of view of the question under discussion I am merely a layman. The only education along medical and public-health lines I have had is rather desultory, consisting in having for the last few years presided over the deliberations of the faculties of our schools of medicine and hygiene and public health. Under these conditions, I would not have volunteered—the honor which I am enjoying has been thrust upon me by the Surgeon General.

I am very much interested in what has been said here to-day, and I quite agree with what has been said during the last papers which I suppose I am expected to particularly discuss—that is, the necessity of making the profession of public health rather more attractive than it is at the present time, through securing permanency of tenure and possibly through the raising of compensation, though I imagine we must expect for a long time to come, as in the teaching field, that those who come into the public health service will be attracted by their love of the work, and their appreciation of the opportunity they may have, rather than by the hope of any great financial return.

But in order that any of these things shall be realized, it seems to me that a different attitude has got to be assumed with regard to public health than has been assumed by most of those that have spoken to-day. In fact, I think it is rather remarkable that there has hardly been a reference to the fact that public health is a branch of general public administration. There has been a lot said about selling public health to the public. You don't sell anything to anyone who hasn't any choice as to taking what you give him. Public health is after all public administration and police administration. It fundamentally has back of it the power of the State. The exercise of police powers will usually arouse a certain amount of opposition because its effect is necessarily to limit individual freedom, indeed, not only to limit individual freedom but as well to impose pecuniary burdens upon the property owner. Until, therefore, we appreciate that public health administration is a part of public administration generally and that it presents much the same problems which public administration generally presents, I doubt very much whether we shall be able to get the people of the country to treat it any differently than it has been treated up to the present time.

We have had a frank statement by students in medical schools of their estimate of public-health administration. This estimate is not a favorable one and would appear to be a straw which shows the way the wind is blowing. The question that has arisen in my mind during this discussion is how are you going to get the public to have a different attitude toward public-health administration from what they have often had in the past. It seems to me there are four things that must be done.

In the first place, the public-health administration must be well organized from the point of view of administrative efficiency. At the present time the public-health officer does not discharge all of those functions of government which have to do with the public health. Certainly he doesn't discharge all functions that have to do with public health and safety. Living in New York City for a time, I found there were five distinct authorities that property owners had to deal with which had something to do with public health or public safety. There was, first, the department of public health; second, the tenement house department; in the third place, the building department; in the fourth place, the fire department; and in the fifth place, the labor department at Albany. The property owners receive communications from these various departments, some of which are sometimes contradictory. They tell a story of a man who received word from one department he must tear down his house and from another department that he must repair his house. He wrote and asked which he must do first. Public-health administration should be treated as a part of the general administrative system and organized efficiently so as not to confuse and exasperate the individual with whom it comes in contact.

In the second place, I have gathered the impression—it may be wrong—that the public-health administrators in this country have in the past made many serious mistakes. For example, for a long time the most effective remedy against yellow fever was supposed to be what was sometimes called the "shotgun" quarantine. I have obtained the impression that the shotgun quarantine was not so much the thing to have adopted in order to stop yellow fever as was the doing away of a particular mosquito that carried that disease. But a great economic burden was imposed upon the country as a result of a mistake on the part of the public-health administration. I have obtained another impression. Very commonly throughout the country we have insisted, largely at the behest of the public-health administration, on a very expensive system of plumbing, on the theory that sewer gas is deleterious to the human system. Now I gather—I may be wrong—that the present idea is that sewer gas is on the whole harmless and that germs are not carried by it. These two illustrations have occurred to me indicating that we need to use very great care in the determination of the actual concrete measures that will have to be enforced at great expense to the individual. Until you get the public convinced that these measures are absolutely necessary it is difficult to develop the proper public opinion with regard to public-health administration.

In the third place—and here what I say, I want to say with extreme caution—I think that the character of the public-health officer, particularly that of the officer of lowest rank who comes into direct contact with the public, is a matter which should receive attention; the character of all officers who discharge police functions is a matter of supreme importance. I had a personal experience which I have never forgotten. I had charge of a building in a large city in this country which was used for purposes of manufacturing. I received word from a department which was discharging public-health functions, not technically a public-health department, informing me that the air in that building was so vitiated that a very expensive ventilating system must be put in. I went down to see the person representing the board and asked him what the evidence of this condition was. He told me that he had jars in which they put the air and had tested it, that the jars were in the department, and that I could not test them myself or have them tested in any way. He handed me at the same time the names of two ventilating contractors to deal with. I went away from that office with the idea that everything was not as it should be.

I do not make the claim that there is graft in our public-health administration, but with the enormous powers which the authorities having to do with public health and safety possess, there is a great opportunity for graft, and no system can be successful as a police administration unless great care is taken to insure the character of the individuals who are in it. Until that is done, no matter how well educated they are, the public is not going to have any more confidence in public-health administration than it has in police administration generally, and will not be willing to accord to public-health officers the position which they should have if they are to do the best work.

In the fourth place, a solution must be made of the problem which comes up in connection with all police administration, viz, how to reconcile the demands for social protection and the demands for the protection of individual rights and personal freedom. My studies along public-health lines, if I can say I have made any studies along those lines, have been with regard to the administrative side, and to my mind we have not yet in this country solved satisfactorily that particular problem. Either we give too great recognition to private rights or, on the other hand, we give too great recognition to social needs. It is a problem that hardly could be asked of the physician to solve. It is a problem which the lawyer has not solved up to the present time. The Commonwealth Fund in New York has made an appropriation for a systematic study of administrative procedure with the hope that some solution may be found. I trust that success will attend this investigation.

Now, these are the thoughts which have come to my mind as I have sat here. I may be wrong in some of the statements which I have made. If I am, it has been due to the fact that I have not had the advantage of a medical or public-health education. But I feel very strongly that a large part of this problem can be solved only after we have solved the administrative side of it. Notwithstanding that Doctor Freeman said the health officer is not a policeman, as I see it he is fundamentally a policeman, and as long as he is he has got to be treated as a part of the general administrative system.

Dr. L. L. Lumsden:

I think that all of us who have had much practical contact with our public-health problems should feel encouraged with the general trend of discussion that has taken place here to-day. I think one of the important principles which has been accepted and which every one of us should endeavor to spread after we have left this conference is that public-health service is a work in itself; that it is not a branch of medicine, or engineering, or biology, or chemistry, or law, or any other science or profession, but a field of service in itself demanding for its effective development the very best the Nation has. If we will exploit that idea, we may do much to overcome the as yet rather natural misunderstandings about the meaning of public-health service.

The answers from medical students to the questions which Professor Jordan sent them impress me as very significant. Since those several hundred students, who are considerably above the average young man or young women in education and intelligence, have such remarkable misconceptions about the nature of and the opportunities furnished by the field of public-health service, it should not be surprising to us that public-health work receives no better support than it does from our citizens generally and their representatives in legislative bodies. If a concrete suggestion may be injected into this abstract discussion, I suggest that a committee of this conference prepare and have sent to those medical students a statement presenting succinctly what public-health service means. Such a presentation might have in time a far-reaching influence for good.

Another concrete suggestion which I wish to submit is action by this conference directed toward the discontinuance of the use of the term "preventive medicine." I never hear that term without feeling something of a shock. It is misleading, inept, and literally ridiculous. It has no more justification than would "preventive engineering," "preventive bacteriology," "preventive law," "preventive carpentering," "preventive farming," or "preventive cooking." Sulphuric acid lemonade to prevent lead poisoning or quinine to prevent malaria might properly be called preventive medicine; but the installation of a water-purification plant or a sanitary sewerage system or the institution of quarantine measures to prevent the spread of infection can not be brought within the proper meaning of the term without a remarkably wild stretch of a biased imagination. The term was born of and helps foster part-time pseudo-health service by practitioners of "curative medicine" who in many instances are untrained and otherwise unqualified to administer what public-health service now means. I am convinced that a well-directed educational campaign for the abolishment of the term "preventive medicine" as a synonym of public health work would remove some of the prejudice against public health work.

In regard to the qualifications of health officers: There is no gift, no talent, no training, no experience which one may have which may not be of use sometime to one while serving as an administrative health officer. The health officer is not only a teacher, a propagandist, but he is also an administrative officer with distinct police functions. I think the most important single qualification of a health officer is not what one may get at a public-health school or any other kind of school but a gift which can come only from God, and that is a capacity to convey information to people generally in a way which will carry conviction; which may be called in a general sense the power of salesmanship. We can do much for the public health service of the future by encouraging those who have this gift to take training for public health service and discouraging those who have it not from undertaking training for a career in the public health field.

What can we do to make the field of public health more attractive to those suited for it, and with a chance to obtain proper training for the work? Among the things which I think most important are:

1. To advertise the nature of the work and the opportunities for a successful, happy career in this field, so that it may make an appeal as other arts, sciences, or businesses do. The public-health field has not been duly advertised. It is comparatively new. In our extensive rural districts, comprising about 50 per cent of our population (and they should comprise more), there was no health service approaching adequacy under the direction of a whole-time local health officer until 1911. Since then reasonably effective health service under the direction of whole-time local health officers has been established in about 160 counties, or comparable districts, comprising about 8.3 per cent of our total rural population. That is not rapid progress, but it is progress. I can conceive of no field in which there could be greater need or more opportunity for useful

service to our fellow kind than is furnished in the field of local rural health service. We might exploit more than we have been doing the work of our pioneer county health officers. Inspiration for great stories like unto those told by Ian Maclaren about the country doctor might be found in the work of the county health officer.

2. To convey to the health worker an appreciation of the value of the service being rendered. I find frequently among local health officers who are doing wonderfully good work a lack of consciousness of the value of the results being obtained from their work. Within the last few weeks I have visited several counties in which the death rate per 1,000 had been reduced from two to five points as a result of the activities under the direction of whole-time county health officers, and the health officers themselves somewhat low spirited because they did not realize what they had been doing and were doing for their counties, their State, and their Nation.

3. To convey in every way possible to the citizenry of this country some idea of the value of health service so that the people may become willing for their health workers to be given at least a living wage and perhaps even a monetary compensation comparable to earnings in other fields of very much less importance to the general welfare. If you, who are the leaders of public thought about public health work, spread the idea that the maximum salary to a well-qualified local health officer should be only $1,500 to $3,000 a year, you will help send into other careers young men and young women who would make good health officials but who can not or will not consider spending years of time and thousands of dollars in money in training for a career which will not provide along with the necessities a few of the comforts of life.

4. Spread the idea that one in the public-health field may perform the highest patriotic service. When we entered the World War we had but a nucleus of an Army. But the American spirit was thoroughly aroused and every one of us who was any good was willing to give anything and everything to help. We did not have time to send our young men to West Point or Annapolis or other schools for prolonged intensive military training. We had to do the best we could with what we had and do it quickly. Within a few months we put into the field a great Army which even the enemy had to admit was rather effective. If the American spirit should become thoroughly aroused to the importance of attacking the common enemy, preventable diseases, which is always within our gates, we would do things for disease prevention and health promotion such as have never been done on this globe. Though there is now in certain groups here and there an apparent reaction from our remarkable display of patriotism during the war, I believe it is apparent and not real. I believe there is in the heart of every American a love of country which can be

appealed to effectively at all times of national crisis and even in times of peace. And I believe that if we of this conference will spread the idea that the public health field furnishes one of the very best opportunities for patriotic service, we will help to activate the interest of our young men and young women in public health work as a career.

MORNING SESSION, MARCH 15, 1922.

REMARKS BY THE PRESIDING OFFICER.

Dr. HUGH CABOT, *Dean Medical School, University of Michigan.*

The program, as it has been arranged, clearly seems to follow a sequence which, I think, is very logical. We have had something of the history of the questions we are discussing and learned a great deal from a group of experts, who pointed out a great many desirable changes and developments. Coming down to brass tacks, we have some people who are particularly well equipped to say what may be done to develop the situation of which we have heard.

Obviously the simple description of desires and the necessities of a situation do not get us very far. The important thing is for us to say what beginnings can be made, what possibilities there are of laying a foundation for the desirable things which have been suggested. After all, these efforts must be made through the established lines of communication, through the machinery which now exists. It is probably not desirable to set up new machinery; it is certainly not likely to be possible, and it, therefore, comes down to a question of what uses can be made of existing machinery and how those charged with the broad questions of education are going to take up this task.

The first speaker to-day is one of a group who must face this as one of many problems of education and a problem of education which spreads widely through the community. President Angell has had a very broad training; he has very broad views. His relation with many teaching institutions makes him particularly well equipped to say in what way the universities may approach this problem, and what we may expect from them in the way of assistance.

V. HOW SHALL THE SANITARIANS OF THE FUTURE BE TRAINED?

WHAT MAY THE UNIVERSITIES OF THE UNITED STATES DO THROUGH THEIR VARIOUS COLLEGES TO MEET THE NEED FOR MORE AND BETTER TRAINED SANITARIANS?

Dr. JAMES R. ANGELL, *President Yale University.*

I find myself a good deal handicapped by not having had the privilege of attending the previous sessions, in which you have been developing the general lines of that which the program provides. I am, therefore, quite unaware as to the points on which I will be repeating what you have already canvassed.

In analyzing the topic in my own mind as assigned to me by Doctor Cumming, it seemed to me the answer was so simple that it did not justify my coming or any other layman coming to present a statement at all. For if you ask what the universities can do to further the public-health training program, in a sense, they can do everything; in a sense, from them the resources must be drawn for the actual carrying out of the larger part of this task. The only aspect to my knowledge they can not do, they can not handle, is what may be called the field service end of it, where, for the most part, all they can do is to furnish some guidance and some suggestions. Necessarily they must look for field discipline to other agencies.

In addition, there is the question of the arrangement of the actual curricula in terms of which you shall undertake the training of these men who are going into the general service of public health. That is a question to be decided not by laymen, like myself, but by you men who are in the business, who are more directly responsible for the conduct of it, and our part rather as university administrators, as laymen, is to try to assist you in carrying out a program which you on the whole decide as wise. It is chiefly as part of the general interested public—for this is after all a matter of fundamental public interest—that we who are administrators are put in the position of being asked to sit in with you at the beginning of the development of any plan, from our point of view, representing one particular group of the public which may be properly heard.

I have felt that my task this morning is of a rather perfunctory character—to say a number of rather obvious things, which, if they have any value at all, will offer points of attack, points of critical comment, perhaps some crystallizing of some of these issues, nothing more. I do not propose to discuss in any detail the question which I find in my contact with public-health work and also with educational officials who are engaged in this type of work, is of most immediate interest to them, namely, the question as to which of the several possible programs which are now before us in this country for the training of sanitarians shall be ultimately followed. I feel, on the whole, it is wise that we do not stipulate any definite plan that may be followed at this time.

Obviously, before any final statement can be made regarding the possible contributions of our American universities to the training of sanitarians, there must be some general agreement as to the qualifications which such individuals should possess. At present there appears to be a wide variation of practice, due no doubt to the relatively recent development of the profession, but also in part to the seemingly diverse views which are entertained by those now in the field. Meantime there are several general considerations which are relevant to the situation and upon certain of these I shall venture to comment.

Possibly not the least of the services which universities can render is to be found in a broader emphasis on their part upon the character and extent of the demand for men in public-health work and the attractions which the career holds out to those imbued with a desire to render genuine public service in a calling which requires rigorous professional attainment. There is reason to believe that at present university men are quite inadequately informed regarding the opportunities open to sanitarians and public-health workers. As a result, relatively fewer students give serious consideration to this calling in choosing a career than might well be the case. Medical students, to be sure, are apt to have some knowledge of this field, but as a general rule their information is fragmentary and oftentimes far from correct. This fact, together with a frequently unsympathetic attitude on the part of their instructors and a belief that the financial and professional rewards are unsatisfactory, serves to discourage any possible disposition on their part seriously to consider this calling. It is a common shortcoming of our American colleges and universities, which many of them are attempting to overcome, that they give their students so meager and so unreliable guidance regarding the choice of a vocation. The failure to do this in the case of the work of the sanitarian is therefore but one instance of a general defect which can, however, as regards this special field, be rapidly overcome by a moderate amount of judicious effort.

Perhaps the most urgent immediate need is a fairly sharp definition of the standards to be upheld in public-health work, both as regards the personal qualifications of those who should be permitted to enter upon it and as concerns the professional training to be required. If clean-cut standards and qualifications can be established (although such an outcome will undoubtedly take time) it may confidently be expected that medical men in particular and the thoughtful public in general will come to accord a position of respect and confidence to this relatively new profession which at present it does not uniformly enjoy. If the universities can contribute in any way to this result, either by molding public opinion or by creating the best conditions for the training of the sanitarian, it is an obligation which they will undoubtedly gladly assume. Indeed, not a few have already given the most serious attention to the problem and, as is well known, we have in a number of institutions excellent beginnings which promise much for the future.

In institutions which can properly undertake to establish departments for public-health work, or in those which already have such, the question of the specific courses and facilities which can be put at the disposal of such a department is likely in large measure to settle itself. But even in such cases there will certainly be a substantial demand for cooperation on the part of other departments which calls for a definite attempt on the part of the university administration to create a sympathetic and intelligent understanding of the problem of the sanitarian. In institutions where a department of public health is not within the range of possibility, it should still be practicable to afford considerable portions of the necessary training by utilizing such courses as are pertinent to the equipment of the public-health worker. It may be assumed that in the latter case such training would be of a preliminary character, comparable to that received in the premedical sciences by medical students and that the final training would be received in an institution specially devoted to public-health work. A systematic effort to draw the attention of the smaller colleges of the country to this field of work and to the possibility that they should contribute some helpful portions of the required training would doubtless produce results of a significant kind.

It is a familiar experience in the development of professional schools connected with universities that the former are apt to be dissatisfied with the courses offered by the general service departments and that they desire to build up their own special courses to meet their peculiar needs. Engineering schools are apt to wish in this fashion to conduct their own chemistry and physics and sometimes their own modern language instruction, rather than to take that which is given for general purposes by the colleges of arts and science. This is a tendency readily understood and perhaps in many cases justifiable, but it frequently leads to a multiplication and duplication of instruction and equipment which require convincing justification. The creation of any new profession is likely to raise demands for a form of training which cuts across a number of the other already existing professional fields. In the present instance we have obviously a convergence of interests now represented in medicine, in engineering, in civil administration, and in certain fields of pure and applied science, to mention no others, which compels us carefully to study the wisest methods of utilizing extant resources and the best form of organization under which to proceed. The relatively new program required for the training of our sanitarians raises this question of coordination all along the academic line. Shall the bacteriology, for example, which is by common consent an essential part of the training of any such student, be the bacteriology given as an independent science in some institutions, shall it be that offered to the ordinary medical student, or shall it be particularly adapted to the real or supposed needs of the public-health worker? Other instances need not be cited, but many will suggest themselves. The issue affects the extent and character of the cooperation which other departments can be reasonably asked to make in advance of such a condition of things as may ultimately be developed where a school or department of public health will have within its own personnel command of all the special courses which it desires.

Confining attention for the moment to the problem of the health officer, or the public-health expert, and disregarding the case of the nurse, I gather that the general desiderata upon which there is material agreement would run somewhat as follows: A good general education involving at least two years of collegiate training, with reasonable familiarity with literature, including a reading knowledge of one or two foreign languages, some acquaintance with at least American history, a rudimentary knowledge of mathematics and similarly of biology, psychology, chemistry, and physics. Any additional training in government, economics, sociology, law, the earth sciences, architecture, and the humanities would all be to the good. Superposed upon such a foundation there would be presumably physiology, anatomy, including histology, biochemistry, bacteriology, pathology, pharmacy, hygiene, sanitation, preventive medicine, and vital statistics. Where the medical degree has to be secured as part of the training, there would be the usual clinical subjects in medicine, surgery, pediatrics, etc.

In the preceding requirements, it is clear that relatively little modification of ordinary college curricula would be required in according men going into public-health work such general training as may wisely be given during the first two college years. The subject not generally presented, which might perhaps most wisely be added, would be a conspectus course of the social sciences, both theoretical and applied, which early in the training would give a man the essential social outlook and the conceptions of social organization and administration which distinguish so sharply the necessary training for this field of work from that of the physician as now generally conceived. Not less than the so-called social worker, whose field is that of general philanthropy and the remedial social activities which characterize so definitely our modern occidental civilization, does the worker in public health require this definite knowledge of social phenomena and the point of view which goes with it. To be sure the insistence upon this conception of the profession and upon this attitude of mind should never be relaxed from the beginning to the end of the professional course, and undoubtedly at sundry points in the later training specific and detailed information should be given which would illuminate and enrich the general equipment of the candidate. But it seems to me at least quite important that this outlook should be introduced at an early point in the training.

Doubtless it will be said that relatively few men will have decided upon their entrance on this career at so early a date as is suggested by the comments of the previous paragraph. Probably this assertion is correct, but it does not detract from the validity of the suggestion for men who do decide at an early stage of their training and it emphasizes a consideration which I believe to be of prime consequence, regardless of the particular stage in the individual's development at which he makes his choice of this calling.

When one comes to the group of premedical sciences which most exponents of public-health training seem to regard as essential, one meets the question already raised regarding the extent to which the form in which these sciences are now presented for other purposes should be modified to meet the needs of the sanitarian. Physiology, histology, bacteriology, hygiene, sanitation, and a few similar topics are frequently presented as parts of a general collegiate or university training and, as such, are taught from the point of view of pure science. All of them are also taught, together with human anatomy, pathology, pharmacy, and other similar topics, as part of the premedical course, and in this case from the point of view of medicine conceived generally in the interests of the practitioner to be, but sometimes with appreciable emphasis upon the scientific and research aspects of medicine itself. If one were not subject to the exigencies of time, it would probably be generally agreed that such subjects as bacteriology and physiology should be taught as fundamentally as possible from the point of view of the science as a whole and the thorough mastery of its essential principles. But with the crowding of the curricula, which characterizes all professional training, and particularly medicine, it is a familiar experience that pressure is brought to bear to present primarily those aspects of the science which are thought to have most direct significance for the subsequent professional work. In the measure in which this tendency is justified, we may expect to find the sanitarian urging that these subjects be presented in such form as to represent the greatest utility for the public-health worker and the least expenditure of his time, compatible with his attainment of a reliable mastery of that portion of the field peculiarly important for him. The demand for this modification is likely to be as definite in the case where the science is taught as part of the premedical curriculum as it is where it is taught from a less specialized point of view. In either case, unless the work in public health is set up as an independent school or department with its own staff to carry these courses, the cooperation of the departments actually in charge of such work must necessarily be gained if students of public health are to have their supposedly peculiar needs met by modifications of the course of study. In such adjustments the central university administration is generally powerless to do more than bring together the high contracting parties under reasonably favorable conditions for conference. The outcome rests upon many circumstances which need not be detailed at this moment.

It is probably needless for the outsider to hold up at this point a warning hand and to direct attention to the dangers which lie this way. Good rule of thumb workers can be produced by short-cut methods. Fundamental scientists with real grip upon their field of work are not produced in this manner, and whatever compromises may be necessary in the interest of abbreviating the cost and the time of professional training must never be allowed to extend to such a point as to menace the essential value of the service rendered. Particularly is this true in a field where it is so necessary to gain and retain public confidence and where ignorance masquerading as trained science may work such serious damage.

Speaking as a psychologist rather than as a university executive, I should think it wise to direct the attention of men responsible for the training of the public-health career to the considerable practical significance of certain phases of modern psychology. With much of what passes for psychology in the public mind I have only unmitigated contempt, and I am particularly impatient of some of the unscientific extravaganzas which have connected themselves with the name of Freud. This is not to deny certain real contributions made by Freud and his followers to our knowledge of the organization of human character. But, on the other hand, there is a considerable body of thoroughly solid technique connected with the field of applied psychology which can be made of distinct significance in connection with the public-health program, particularly as this can be linked up with the work of the public schools and certain aspects of the problems of industry. Some familiarity, both theoretical and practical, with the methods of identifying subnormal mental stock, some familiarity with the technique of the classification of personnel, in its relation to both educational and industrial processes will, I am sure, prove itself of substantial value. Similarly, there would no doubt be frequent occasions in which a rudimentary knowledge of psychiatry would prove of value, but how far one can go into specialized fields of this kind necessarily depends upon the available time and the educational facilities at hand.

It is probably presumptuous for the mere layman to express any but the most tentative opinion regarding the relation of this entire program of public-health training to the present curricula of the medical schools, with which, needless to say, the relations must be more intimate than with any other single division of the university. The several plans which have been proposed doubtless all have merit. For my own part, I do not venture at this time to enter upon any evaluation of the several programs known to me, but I do venture to assert that in my judgment there are good reasons for urging that the professional sanitarian or public-health officer should hold a medical degree. I do not by this expression mean to commit myself to the proposal that the sanitarian shall pursue from beginning to end exactly the same course which would be followed by the man expecting to make the private practice of medicine his life work. I believe, however, that the practical advantages which accrue from the possession of the M. D. degree by the sanitarian are to-day at least highly important and such as quite outweigh the disadvantages which may be urged against it. Assuming therefore that the training given en route to the medical degree is not identical in all particulars with that given to the regular physician, there will obviously be need at this point for some cooperation on the part of medical faculties, but such cooperation ought not to be very difficult to secure, in view of the slow but definite growth in plasticity in the later stages of the medical curriculum. Viewing the situation as a whole, it would appear that the great body of the training material required for meeting the demands of any of the ideals now entertained for public health workers could be met by the larger universities which have engineering schools and medical schools. Not a little of the training now offered is directly and immediately available and most of the rest could be obtained by reasonable and moderate changes in the present courses of study offered. In a few instances there will be the need of introducing outright new work and from beginning to end there will be the necessity of informing the entire program with the professional spirit of public service. Even though the sanitarian go into the employ of a private corporation, the work required can not be successfully accomplished in any spirit except that of a large regard for the general public welfare. Carried on in such a spirit, surely there are few professions open to the young men of to-day that hold out more of stimulation and inspiration to bring to the service of the community the best powers of trained intelligence and modern science.

A PROPOSED CURRICULUM FOR A SCHOOL OF PUBLIC HEALTH.

GEORGE C. WHIPPLE, *Professor of Sanitary Engineering, Harvard Engineering School.*

In a paper published in the International Journal of Public Health last year I outlined in detail a one-year program of studies which to me seemed suitable for the instruction of a doctor of medicine who desired to become a health officer. It was based largely on present English and American practice and was intended to arouse the interest of the universities of the world in public-health education. Since its publication dozens of letters received from universities in Europe, South America, Asia, and Africa have shown that everywhere the subject of public health education is attracting attention. Our present problem is not the general one of setting forth the subject from a world-wide standpoint but that of outlining a curriculum suitable for an American school of public health.

In the first place, we must consider what the purpose of such a school should be. My conception is that it should be a branch of a university parallel with the medical school and the engineering school and closely affiliated with both, just as health itself is concerned with the human body and with its environment. Its primary function should be to give men opportunity to pursue such studies as will fit them to become executive or administrative health officials in the public service of city, State, or Nation. A second function should be to train men for special branches of the public-health service for bacteriology, for water analysis, for food analysis, for epidemiology, and to cooperate with the engineering school in training sanitary engineers and with the school of education in training teachers of health. In other words, there should be two types of program for two types of service which correspond, in a way, with the line and the staff of the Army. The line officers—that is, the executives—need the more general studies; the staff officers, the specialists, need the more detailed studies in a single field.

I shall not attempt here to discuss a proper curriculum for the specialist. I assume that each school of health will develop special lines of study in its own way and that each professor will in fact teach his specialty in his own way. It is best that no standardization be attempted in these matters. The field of the specialist should be full and free. One school will do one thing, another school will do another thing, as men and means and opportunities permit. The staff officers of our public health service need all the originality they can muster, for it is largely through them that the arts must advance. But the line officers in the public health service need a broader and more uniform training in the interest of cooperative effort and in order that uniformity of administration may result in better enforcement of public health laws and regulations.

My idea of the qualification of a health officer is a man learned in the medical sciences who has had special training or experience in public-health administration. Personally I do not believe that the degree of M. D. is necessary if he has received a properly administered degree of Dr. P. H., but I recognize certain practical advantages of having both degrees and believe that for the present we should go ahead on that basis. The Dr. P. H. needs something which the M. D. does not need and which he usually does not have—the ability to view a community as a whole, to visualize community health from statistical data, to think in terms of the mass instead of the individual, to estimate quantitatively the effect of environmental conditions, and to appraise the benefits to be derived from expenditures of money for public-health purposes—in short, a health officer should have what may be called medical statesmanship. And a school of public health should give this point of view to its students. If it does not do so it is bound to be a failure. It is not enough to get together a program of studies on the special subjects with which the health officer is likely to deal; it is not enough to provide eminent specialists to give lectures in different fields. Unless the spirit which pervades a school of public health is different from that which exists and which should exist in a medical school, it will prove to be a useless addition to our educational institutions. Physicians should be trained for personal, individual service; health officers should be trained for community service. Whatever studies are taught in a school of public health—and of course there must be specialties—it is of paramount importance that the dominating men in the faculty should be medical statesmen, sanitary statesmen, public-health statesmen, or whatever we choose to call them. Unless special efforts are made to secure men of this type, I have grave fears that the new schools of public health will either become mere attachments to medical schools or collections of specialists jealous for their own branches of science. To my mind, therefore, the spirit of the school and the controlling desires of its dominating instructors are far more important than any program of studies and should receive first attention. And it seems to me that the studies pursued in a school of public health should be so chosen and apportioned as to time that the students will acquire this spirit of community health.

The apportionment of time for different subjects should also depend upon the difficulty of learning them and not upon their relative importance in after-practice. The academic history and habit of mind of the expected class of students must be given consideration. Eight years' experience in teaching sanitary engineering and vital statistics to medical and nonmedical students has shown that, even after allowing for certain age differences, the men who have chosen medicine for their profession have greater difficulty in using figures even in simple ways and greater difficulty in grasping mathematical principles than the others. Students have repeatedly said to me, "Vital statistics is the hardest study I have." And it is much the same with sanitary engineering; it is hard for men who do not have a geometrical sense to visualize engineering works from maps and plans. The reason is obvious—they have a different type of mind and they have not had the requisite preliminary training. The same thought may be extended to laboratory work. If the students are doctors of medicine several years removed from their medical school, their ability to use the balance and the microscope and to conduct the ordinary laboratory manipulations will be found to have almost vanished. It is for this reason that in a suggested curriculum I have allotted what might otherwise seem a disproportionate amount of time to statistics, sanitation, and laboratory courses. Granted that many of the things taught in hygiene, preventive medicine, and epidemiology are of more practical importance, they are much easier for the medical graduate to grasp. If, however, a curriculum is being made up for nonmedical students, the same principle holds and greater time should be given to hygiene and preventive medicine than to sanitary engineering and statistics.

The curriculum need not cover the whole field of public health in a detailed way, but the program should be so arranged that each student comes in contact with those members of the faculty who represent the leading subjects of importance. It seems to me that this personal contact is far more important than the scheduled subject. Let me illustrate. In the School of Public Health of Harvard University and the Massachusetts Institute of Technology, we were particular to have each student take at least one course with Professor Sedgwick. It made little difference whether it was epidemiology, or personal hygiene, or something else. It was Sedgwick that we wanted the students to know. Sedgwick was a man who was more interested in his students than he was in the science which he taught. Such a teacher is the greatest asset which any school can have and every school needs at least one such man.

The students' program should not all be prescribed. Some time—at least a tenth of it and preferably more—should be left for him to spend as he pleases, in extra study or in some field in which he has a personal interest.

Yesterday, after listening to many suggestions to include this and that special subject in the course of study to be pursued by students in the school of public health our minds became confused. In my opinion it is not at all necessary for students to study all of these things. There are 52 cards in the pack, but only 4 suits. It is not necessary to study every card, but they should become acquainted with every suit. A year's course or a two or three years' course should mark the beginning, not the end, of the student's education. In 1917 when I was in Tokyo on my way to Russia I stopped at a small shop, curious as to the wares displayed. A little Japanese boy came out and spoke to me in fairly good English. I asked him where he learned to speak English and he naively replied, "We have books in Japan." We have books, too, in America—books on this many-sided problem of public health, and the health officer must educate himself by continued study and, what is more effective, by experience. All that any school can give a student is motive power, a map, and a desire to travel; he must make the journey himself.

In my paper on "The Education of Health Officers" I suggested a model program for a one-year course for medical graduates, which, with some modifications, I offer as a basis of discussion.

The idea has been to found the program upon five leading subjects, each of which is carried through the year—hygiene, sanitation, preventive medicine, statistics, and public-health administration. Realizing the lack of accepted definitions and much overlapping of terms, a somewhat detailed list of topics was given for each subject. Of course, these would not fit any one school and the list is far too long for a single year's program. It was intended to be illustrative of the scope of the topics.

The hygiene of the human body should be kept in sight throughout the year, first the theoretical and afterwards the practical side.

The sanitation of human environment should be kept in sight throughout the year, studied first through chemistry and biology and then through sanitary engineering.

The important rôle of the microorganisms should be kept in sight throughout the year. Bacteriology would naturally be taken up first and then developed into the broadening science of preventive medicine, including parasitology.

The use of statistics and other methods of visualizing and detecting the permeation of diseases through a community should be kept in sight throughout the year, and this naturally involves vital statistics first and later the much broader principles of epidemiology.

Finally the principles of public-health administration should be kept in sight through the year—law, legislation, and administrative methods.

In explanation of the percentage allotment of time, I may say that the low figure of 10 per cent given to hygiene in the first term was due to the fact that medical graduates are presumably familiar with the subject and need only to have their knowledge reviewed and brought up to date; while the high figure of 25 per cent given to it in the second term was because of the rapidly developing applications of hygiene in the modern health movement. Bacteriology and sanitary chemistry and biology were each given 25 per cent because they are essentially laboratory courses and require much time. Perhaps, however, this time ought to be lessened and more time given to vital statistics, for I am sure that the students will take more time for this subject whether it is given to them or not.

As to the arrangement of work, it is my idea that the best results can be accomplished by having those courses which involve a good deal of laboratory work conducted on the intensive plan—that is, several hours a day and every day of the week for a part of the term. The other courses which involve lectures and much reading should be spread through the year. Perhaps the following might prove satisfactory:

Proposed arrangement of studies for a one-year program.

	Per cent.
First term:	
Laboratory courses—	
Bacteriology	25
Sanitary chemistry and biology	25
Lectures chiefly—	
Vital statistics	20
Hygiene	10
Law and legislation	10
Elective	10
Second term:	
Laboratory courses—	
Applied hygiene	25
Epidemiology	25
Lectures chiefly—	
Preventive medicine	20
Sanitary engineering	10
Public-health administration	10
Elective	10

According to this plan the student would spend half of each day in the laboratory and have two prescribed lectures each day. In the first term he would study bacteriology three hours a day for two months and after that devote the same amount of time to sanitary chemistry and biology. Meantime he would have throughout the first term six hours of vital statistics, three hours of hygiene, and three hours of public-health law each week. In the second term he would devote half of each day for two months to laboratory work in hygiene and then to epidemiology and have six hours of preventive medicine, three hours of sanitary engineering, and three hours of public-health administration each week. Obviously, practical considerations in each school will require some modification of this arrangement.

I believe strongly in giving the student some practical experience in the field. This may take the form of actual work done under the direction of a health officer, reports of visits to sanitary works and institutions of various kinds, the making of a sanitary survey, or research work. Students need to get the right perspective of things, and they need to do something original. The making of a sanitary survey is an excellent means of rounding out their course. In making a survey, they are conducting a sort of community clinic. They come to see the relation of things. But it is my opinion that this should be done after their year's work and not during the term. A survey can be made best on the intensive plan. To attempt it during term time cuts into other studies in an unwarrantable way. It tends to make students work overtime and thus lose the benefits of necessary leisure on Sundays and holidays, which is quite as important to students as to other human beings. Whatever programs we arrange, let us not crowd the students to distraction. Whatever course of study we lay out, let it not be a race course. A school of health may well act as an example to other schools in this matter.

If the course for the Dr. P. H. is arranged to cover two years instead of one, the second year should be devoted to studies in special fields and to original work. The sanitary survey may well be put into this second year. I have not attempted to outline a curriculum for this second year, but I believe that the student should have much latitude in his choice of studies, but be required to take advanced work in some one field. When students finish this work they naturally hope to be recommended for some appointment; hence in their second year they should have the opportunity to demonstrate to their instructors that they can do some little thing well. While the first year of the curriculum should be devoted largely to the acquisition of knowledge, the second year should be given up largely to the strengthening of ability, or, to use Ruskin's phrases, the first term should be lighted by the Lamp of Knowledge, the second term by the Lamp of Power.

In the preceding outline I have had in mind a program suitable for a course in public health, using the words in what may be called an official sense. These words are now used so broadly that their exact meaning is becoming obscure. We used to have "Boards of health;" now we have "Departments of public health." Does this mean an expansion or a limitation of activities in the interest of health? Personally, I do not like to see this word "public" slipping into our conversation unless it means something. Sometimes we say public activities when we mean collective activities; sometimes we say public-health education when we mean popular instruction. Personally I do not like this new use of the word "sanitarian." It seems to me that some of these terms need definition in the interest of clear thinking. When we plan for our new schools, do we have in mind schools of health, schools of public health, or schools for health officials? Johns Hopkins has its School of Hygiene and Public Health, thus recognizing the personal as well as the official aspects. The Harvard Technology School started out as a school for training officials and was called a School for Health Officers. Because of a popular idea that health officers meant "policemen" and because affiliation was made with the department of industrial hygiene of the medical school, the name of the school was changed to School of Public Health. I wonder if the time has not come for us to broaden still more and use merely the fine old Anglo-Saxon word health. Why should not our schools become known as schools of health?

It is because I recognize the complexity of education requirements that I have not attempted to formulate curricula for other than official lines of health work. These, however, should be provided. But until our health activities—public and semipublic, collective and individual, professional and voluntary—are more sharply differentiated and better organized it is well-nigh impossible to arrange programs suitable for large groups of students. Liberal provision should therefore be made for students interested in industrial hygiene, school hygiene, popular health education, physical education, and the like; also, of course, for the specialist in any one of the many fields of official public-health work and for research. It seems to me, however, that every specialist should be required to take several of the major courses in the curriculum suggested in order that he may have a broad outlook on the whole problem of health as it is viewed to-day.

There is one side of public-health work to which the program of this conference has given scant attention, and yet many of the speakers have listed it as a subject of major importance, i. e., sanitary engineering. This subject can be taught best in an engineering school, in an engineering atmosphere amidst drafting tables and maps and plans; in a laboratory where chemistry and bacteriology and microscopy are brought together and used as tools for a common purpose; and in the field where students can see the size and the operations of sanitary works. A proper study of engineering brings in the cost factor, and that is something that health officers need to know. We all look with admiration upon the triumphant work of General Gorgas in ridding Panama of its yellow fever by controlling mosquito growth, but if the Tropics are to be made permanently habitable to the white race, engineers must find ways of securing sanitation at lower cost than at Panama. It is an old saying that "the first step costs," but it is equally true that the aftersteps should cost less. If a health officer is to become a statesman he needs not only the intensive study of the laboratory but the extensive vision of the engineer. He should be taught how to penetrate the secrets of nature in their relation to human hygiene and also, what is of equal importance, how to utilize this knowledge to secure a sanitary environment which shall help to maintain the health and comfort of all the people.

DISCUSSION.

Dr. Victor C. Vaughan:

If the next generation progresses in sanitation as rapidly, thoroughly, and as effectively as the last generation has done, we should be satisfied. Thirty or forty years ago the death rate in this country was about 25. Twenty years ago the death rate in New York City was between 19 and 20. To-day it is between 12 and 13. There has been a reduction in the death rate in the registration area of this country within the last generation of about 7. In 100,000,000 people that means the saving of about 700,000 lives annually. It is the belief of competent sanitarians that it is possible to reduce the death rate to a minimum of about 7. This is going pretty low. I doubt whether the generation of expert health officials that we are going to make will surpass in results the progress that has been made in the past.

How has this progress been made? It has been made by the education of the people. The death rate of a people is a very fair index of its average good sense. And we are not going to progress as we have in the past unless we educate the people, unless the people are concerned in these matters. A great deal has been said decrying the connection between politics and public-health officers. Now I know that we should call it psychology and not call it politics, but every health officer is a political officer, a community officer, a policeman, as it were, and he must satisfy the people, and it is easy to satisfy an educated people and not easy to satisfy an uneducated or ignorant people.

You will pardon me if I refer to some experiences that I had in public-health matters in the seventies, before Koch discovered the bacillus of tuberculosis. The Michigan State Board of Health began to teach, by means of conventions throughout the State, that tuberculosis was an infectious disease. They began that in 1870, and in 1887 we presented to the Legislature of Michigan a request for an appropriation of $100,000 for a State hygienic laboratory. This was managed not by the doctors of the State, no; the doctors of the State were not interested. It was managed not by the university of the State; the university of the State opposed it. It was managed by the Michigan Business Men's Association. The legislature passed the appropriation, which was vetoed by the governor and passed over the governor's veto. The State laboratory of hygiene was established, and it was stated in the bill which established this laboratory that its purposes were threefold. First, and most important, research into the causation of disease; second, the investigation of infectious disease, or diseases in general in the State of Michigan; and, third, the teaching of students along hygiene and public-health lines. So thoroughly were the people of Michigan impressed with the value of scientific work that when an outbreak of typhoid fever appeared anywhere in the State, water was sent to the laboratory for analysis, and the report was accepted as final. In the nineties a private company at Ironwood, Mich., sent to the laboratory a sample of drinking water taken from the water supply of the city. There had begun to appear cases of typhoid fever. It was reported that the water was contaminated. Two weeks passed, the epidemic had grown, hundreds were ill, when the health officer of the city sent a sample. A telegram to him said: "Two weeks ago this water was reported to the superintendent of ——— company as contaminated." The people of Ironwood went after the officer with a rope, and he has never been seen in Michigan since. I tell you, you can get up feeling concerning health matters as well as political matters.

Now, Mr. Surgeon General, this conference which you have called here is capable of doing great work, and I am sure that it will do great work. On the other hand, it is capable of doing great harm, and you will pardon me if I speak very plainly concerning this. If we are going to standardize public health courses in this country, lay down cast-iron rules that a man must do this and a man must do that before he can occupy a position as health officer, then we are doing harm. I hope there is no such sentiment.

Another thing. There are representatives here from the various universities of the United States. Each university thinks that because Johns Hopkins and Harvard have received large appropriations for schools of public health that it also should have a school of public health. Now, every university and every college in this land is already fitted to make men competent to do work along some of these lines. As Doctor Whipple has just said, sanitary engineering, for instance, is taught better in engineering schools than it would be in public-health schools. Bacteriology is well taught in practically all the first-class medical schools in this country, and so on. When you say that a man must know so and so in order to be a successful health officer, think for a moment what are the duties of a health officer. We had this stated to us yesterday. The health officer himself or through his assistants uses all the discoveries in science which can be of benefit in the prevention of disease. No school can teach all these things. No school, however well endowed, however numerous its faculty, can teach all these things. Every first-class university in this country can teach some of them.

So let me beg of you, the representatives of the universities who have come here to this meeting, do not feel that you must go back home and launch a full-fledged public-health department. It is unnecessary, and besides, there should be reciprocity. If the student at the University of Illinois gets his engineering training, and then wants some other special line of work, let him go to Johns Hopkins or Harvard or somewhere else. For 30 years I have endeavored to get permission for medical students to migrate, go here and go there, and all my attempts along that line have been failures. Chauvinism, provincialism in medical teaching—let us not have it in public-health instruction. Let these schools that have been so ably endowed, so abundantly endowed, accept the work that has been done somewhere else.

This conference can standardize the courses in public health. You may say to-day that every health officer must have a medical degree.

That would have great influence, but it would not be legal, it would not be binding upon anybody. And before you do such a thing, remember that a Louis Pasteur could not be a health officer in any village in the United States if such were the law. Many men who have contributed largely to public health have not been medical men. After having been dean of a medical school for 30 years, I hold that the atmosphere of the medical school to-day is antagonistic to preventive medicine. That may seem a strange statement, but it is true. The medical graduate is not fitted to examine the man who comes to him and says, "I don't know that there is anything the matter with me, but I want you to go to work and find out." The student is only educated to take care of the one who comes and says, "I have dyspepsia, heart disease, or something of that kind." The teacher of bacteriology in our medical schools as a rule teaches bacteriology not from the standpoint of preventive medicine, but from the standpoint of the pathologist, and so on. He treats the subject as a clinician, not as one who would teach prevention of disease.

Let me beg of you then that the representatives of university or college present here go back and announce what work along this line each can do and do well. Do not strain a point in order to build up a full-fledged school of public health. For a number of years, at least, the schools that have been so abundantly, so magnificently endowed (and I am sure that we all rejoice in that), supplemented by the other schools which will furnish instruction along certain lines, will be able to supply all the health officers we need in this country.

We are dealing with a comparatively young profession. Let me beg of this conference not to bind its feet. It will walk better if you do not. Do not cripple it in swaddling clothes, but let it grow; do not chain it down to certain definite lines, to cast-iron rules, but let it evolve in a natural and normal way.

Dr. Annie Goodrich:

I would like to commence, as Doctor Winslow set the example by ending, with a text: "To learn the secrets of any science we go to the expert specialists, even though they may be eccentric persons, not to the commonplace pupils. We combine what they tell us with the rest of our wisdom and form our final judgments independently." It is impossible for me even in the brief moments that are given me to present the subject except briefly.

I would begin by reviewing some of the trends of the times. In the first place we ought to consider the trend of the times in industry and secondly in education, and then consider this great problem of public health. As I see it, the people are demanding that the men of the street have the educational advantages not only of the schools but of the institutions of higher education. They are expressing themselves through the intellectuals of the labor party. One continuous thought runs through their writings, that if you are going to have people functioning effectively in the community—and they should function, every one—they should have that creative impulse and interest in what they are doing that energizes them. I might quote from William James, "Knowledge of life is one thing, but the effective occupations of life with their dynamic forces, are another."

There is another movement of great significance—the cooperative movement. It is demonstrated far better in foreign countries than it is in this, but it shows that the people are intelligent; it shows that they are able to do their own great pieces of work. We only have to go back to 1844 to a little group of weavers, almost illiterate, and think of their wheat fields in Canada, their tea plantations in China, their millions of money which they have accumulated.

Let us consider for a moment this question of education. I come, of course, as you noticed, from the Teachers College at Columbia, and those of us who have association with this university are constantly watching the progress of what is called preventive medicine. We have constantly brought before us the works of men who are demonstrating the fact that "Knowledge is power."

Now with these two points of view continually before us, added to the fact that one of the four essentials in education is health, conducing to economic efficiency, it is impossible for me not to think in the terms of the men in the street, and how best we can make this change which is going to affect the whole world. I can not, for instance, for a moment see that any person concerned in the field of health can separate himself or herself from any other person concerned in the field of health. I can not conceive that we should have a practitioner who is interested in the prevention of disease and another practitioner interested in the incidence of disease not cooperating. It seems to me that the persons who function in health should attack the immediate situation of abnormal conditions and while doing so should function in the prevention of that disease, to bring about a future normal situation. As far as health is concerned, I have a number of outstanding pictures in my mind. One is that great congregation of mental patients in our 15 State hospitals in New York. When I was inspector of nurses' training schools, which I was for four years, it was one of the greatest revelations of my life to find that where they had registered schools of nursing 15 were related to the State hospitals for the insane, and that the population in these hospitals was 35,000 out of something a little over 50,000 of the whole number. Yet hundreds and hundreds of nurses had been sent out, and a number of physicians also, who had known nothing of the question of mental diseases. I have not included, above all, that most tragic spot in the islands in the East River—Randall's Island—where we have not only the adult mental and physical cripples, but a great body of little children that are crippled.

Now, I want to speak for the education of those persons who are going to have the most immediate, first-hand opportunity of changing this situation, and concerning the group of women who may function either as nurses or nutrition workers, or as hygienists of any kind, if you like. I can not see any program of health education which does not at once open the doors of higher institutions to those who are prepared to function, not as an overhead, but absolutely and intimately. If you ask me where we are going to get those persons who have that higher education, my reply would be this: That it is predicted by so reliable a paper as the New York Times that in a very short time the number of girls in colleges will equal the number of men. There has been a 156 per cent increase in the last 26 years in the number of young women going to college. The number of girls graduating from the high schools already exceeds three times the number of boys. The greatly increasing group of young women going into the colleges are destined to spend four years at academic work which does not lead them to any effective occupation in life. I protest that these young people should be prepared in the first two years of college life for such a field as we are mentioning to-day. Certainly they should not be wasting their time getting knowledge if they are not going to be put to some effective use. All of the subjects which have been mentioned here, it seems to me, at least many of them, should be part of the curriculum of those young women.

I want to give you one or two things here that I would particularly stress—the nutrition worker and the nurse. We ought to direct hundreds of college women into this field. The reasons are several. Let me just give you a little problem. Two per cent of the persons in the community are constantly sick. If one visited every single case of sickness and the duration of each case was two weeks, do you realize that one would get into contact with 52,000 cases in a 100,000 population in a year? I am aware that I am not considering the incidence of repetition, but every time that person went into a family, that trained person would have the opportunity of giving directions for those members of the family who were healthy, in order that they might continue so.

There has been a great error in our education of nurses. We have mistaken the means for the end. The end, as far as the patient or mother who sends for that nurse is concerned, is the technical procedure of the nurse. But that is not or should not be her end. Her hands have been trained so that her mind is free from her technical procedures. Nothing is better evidence of that than the way she can go from one communicable disease to another without carrying it. Her antiseptic conscience gives her entrée into that home. That nurse has the function of a teacher. If she has been given teaching methods she must teach the people with whom she comes into contact the causes of disease and how disease may be avoided. In this case she is more than a teacher—she is the most important connecting link between the expert specialist on the outside and the family on the inside. She should be able to interpret the message of the expert specialist.

Let me give you an illustration of what has been happening; it is very dramatic but absolutely true. I know of a city block with a population of between 1,500 and 1,800. It has 41 tenements in which not one has a bathtub. There have been over 50 welfare workers in that block in 30 years. Has that block improved? Far from it. There are 41 buildings and not a bathtub in one. What about the mental, moral, and physical condition of these people? We are not yet solving this situation. We are not getting the kind of people enlisted who have the knowledge that will reveal to us the trouble. They should work with these people and teach them to change their own situation. Until these people know their own power, know they can better their tenement conditions, until they have learned the lesson of health, we shall not have any change. We might as well pour our money into a quicksand. Until we teach these people by precept and practice, we are not going to get much of a change.

What do I believe concretely? I believe that there should not be less than two years in a college for the nurse or nutrition worker. I believe all these people should come out speaking the same language. Their common denominator is health, and I believe wherever a nurse connects with a nutrition worker, with a physician, with a dental hygienist or a dentist, that there are certain fundamental things which they should have in common, in order that there may be the least possible waste. I believe the hospital is one of the most important laboratories in which to teach a nurse. The congregation of cases makes it possible to give her in three months an experience that would take her years to get. The trouble is that we segregate our cases in the hospital. We forget they have any past or future, and simply treat a local condition. But if we consider that the hospital is but one piece of machinery—that the dispensary, and all the scientific equipment, rounded up with a group of workers, all have a common denominator—we can put over something in a few weeks or months—something that has never been dreamed of.

Dr. Alexander C. Abbott:

Doctor Whipple has offered objection to certain terminology. I should like to contribute mine, so as to make the picture complete. Unless my conception of this matter is erroneous, public health is the object for which we are striving and public hygiene is the science through which we hope to gain the object. I would suggest, therefore, that the term "public hygiene" be employed for the science instead of public health, as is now customary.

I am pleased to hear President Angell lay such stress as he has upon the fact that the facilities of many of our universities for training in public hygiene have not been utilized. I represent a school that took up this question of coordinating different departments into what might fairly be regarded as competent instruction in public hygiene as far back as 1906. I had no such plethoric treasury as the $500 to which Doctor Whipple has made mention. When the proposition was made to the authorities of the University of Pennsylvania I was authorized to proceed with the plan, providing it could be done without cost. It fell to my lot to coordinate different departments in the university that up to that time had been, very naturally, developing with no consideration of this possible relation to questions of public hygiene.

It is with some amusement that I now recall my discouraging experiences. All sorts of objections were offered by such departments as did not want additional work or did not want the scientific subjects applied to a practical problem. It was necessary to make clear that it was not proposed to train specialists, but rather to give such training as would show the bearing of the subject to the whole problem and create a sympathetic and intelligent interest. It took about two years to get full cooperation. The result of it all is that we have arranged a fairly coordinate course, which from year to year is improving. We are now giving—and have been giving since 1909—the doctor's degree to those persons who successfully pursue this group of studies.

I do not regard this plan as the best one. It is the best that we could adopt at that time. Also it is a plan that can be considered by a very much larger group of smaller colleges than are now considering it. I do not think that we should set so high a standard for this work as would discourage the smaller colleges to undertake coordination of available departments and do something in this field.

The disadvantage of the coordinating plan, as I see it, is that you create almost no atmosphere. I do not believe that it is possible to create that very desirable atmosphere in which work of this kind will thrive best, unless the subjects are in much more intimate touch than is possible where you are coordinating outlying departments under one roof, if possible. I have no criticism to make of the kind of individual teaching that is being given in those outlying departments. It is excellent, but its bearing on the subject of public hygiene is not sufficiently direct. It is a little detached and I believe the result would be infinitely better if the groups were more intimately in contact. But such centralization, desirable as it is, should not be regarded as so essential that nothing can be done without it. Something of very great importance can be done by many schools if they will only do it.

I am glad that this morning we are getting our feet down on Mother Earth, glad also that none of the 380 students who replied to Doctor Jordan's questionnaire were here yesterday. I am quite confident that if they had been present not one of them would have considered going into public hygiene. He would not have known what was to be included, where it was to start, and where it was to end. The boundaries of the field as conceived yesterday were very hazy; everyone seemed to think his own special subject fundamental to success. I feel that the time has come, and hope it will come to-day, when we can at least have a suggestion of a sensible minimum course of instruction that will give to the candidate in this field of work a good idea of what it is all about, some idea of the problem, some instruction that will enable him to become practically familiar with the underlying phases of it, and such a dignified course of study that a university can take the responsibility for certifying that a student who graduates from it is at least favorable material to work on, able when he does go out to give information and to absorb it. He is, of course, no more a "finished product" than is a medical student when he leaves the medical school.

I hope sincerely we shall never see the instruction in public hygiene in the chaos that characterizes the medical curricula of to-day. One thing must be borne in mind in arranging this curriculum. It should contain the essentials but allow time enough for independent development.

Something has been said about the successful health officer. I was a health officer myself for six years. I am not sure that I was a successful one, but in those years one thing impressed itself on my mind every day; that is, it does not make very much difference how much education a man may have in any particular field, unless he knows men, unless he realizes that he is living in a community of human beings, every one of whom, according to our form of government, has a say; unless he is man enough to make them think as he thinks; unless he is able to get the means to carry on his work; he may pose as much as he pleases as a highly scientific health officer. but without these he is a failure. There is something which comes to one with his idioplasm that makes for success. If you do not have it you are bound to be a failure. That quality which makes for success can not be taught. It may be awakened from dormancy under favorable environment.

THE EDUCATION OF PARTIALLY TRAINED SANITARIANS NOW EMPLOYED.

Dr. Roger G. Perkins, *School of Medicine, Western Reserve University.*

The subject assigned to me is the man who now has a job and needs more information. This is not merely a very pressing need of to-day; it is a need which will continue. It has been emphasized by other speakers yesterday and to-day that the progress of getting sufficient teaching facilities to turn out an adequate number of fully trained men is one that will not be finished to-day or to-morrow but will be carried on for an indefinite time. I also feel that no man who is worth his salt and who has obtained a job will ever feel satisfied no matter where he has obtained his training. He will want more training—want to get further advancement. Outside reading will help him to a certain extent. Personal contact will go farther.

The things we have to consider then are, in the first place, who is the partially trained man; second, what are his general broad needs; third, what is being done to cover the needs; and in the fourth place, what can we do to make his opportunity for training better. Most of the talk has been of the health officer of the grade more or less of commissioner. Professor Whipple has referred to the lower grades as of great importance. I have felt that the things we have to keep in mind if we are to run a proper health and hygiene department is that it must be fairly satisfactory all along the line. Anyone who has the experience knows that just as soon as you have weak points in the chain of activities, just so soon is the success of the work interfered with. We can not neglect even the humble technician, because if he does not do his work well, the diagnostician can not do his. We must then consider the sanitarian, including the higher administrative officer, and also a great many posts farther down the line.

As to the particular needs it seems to me that the chief, the head administrator, needs a very broad view of public health. It is impossible—as has been clearly shown by some of the papers which we have already heard—that any health officer should know all that he is supposed to know. But he should have sufficient knowledge of the entire division over which he has control to know whether or not they are doing their work. What they all need is a general health background, but the pictures that we draw will depend upon the individual need of the person for whom we are drawing them.

Since we are trying to work out a new system, we have to look at the pessimistic side first, the difficulties we have to overcome. There are two very distinct difficulties. The first is the indifference of the individual. There are many men who do not appreciate that they do not know as much as they might know if they knew more, and these men will not come forward and clamor for instruction. That is a matter of general education to which we shall refer later on.

There is also the still greater difficulty of lack of time. This depends in part on the fact that the individual, who has to run an underfinanced and undermanned department, does not feel that he can get away, and in part on the lay administration, which is often unable to see any necessity for study on the part of employees. While this attitude is changing, it still obtains in many places. But even where there is willingness to grant leave of absence there are no funds available for travel and the burden is placed on the official, whose salary may find it hard to bear the strain. In some of the larger cities there are courses which are available and which may be taken by the local man or men without too much strain in time or money, but this is the exception.

It is clear then that it is necessary to develop courses which can be taken by the men who desire them and are able to attend and that a careful balance must be kept between the courses which involve so much time that they are impracticable and courses which are so short or so compressed that they do not give results comparable with the effort.

Inasmuch as a great part of the training must be along lines which require demonstration, the teaching for the most part must be carried on in the larger cities. Exceptions may be made in special cases where there has been the development of an ideal county or rural administration which can be used in a series of special courses such as is being worked out in Ohio. But in general one should have illustrative material in the shape of waterworks, sewage-disposal works, child hygiene activities, and so forth, in order to have the widest series of courses of instruction. Unless a peripatetic staff can be developed as a sort of traveling university, a consummation which would at the best be of doubtful value, it will be necessary to go where a teaching staff which is interested in the matters at hand is available.

On the bases already discussed there are three definite possibilities:

1. Brief institutes of the present type, scattered through many cities and with wide scope of subjects.

2. University courses of longer duration in connection with (*a*) schools of hygiene and (*b*) departments of hygiene and preventive medicine. The scope of subjects covered here will probably be narrower.

3. Correspondence courses.

Each of these has its advantages and disadvantages which may be briefly touched on.

The *institutes* are not dependent on the presence of a university, as they can be manned by a combination of the local health officials and a peripatetic staff similar to that which is functioning at present. They can thus be given at a larger number of places and be more accessible to those needing the work. Inasmuch as the presentation of material in a brief time is necessarily didactic, a greater variety of subjects can be taken up, and a general view of the whole subject of public health can be more or less sketchily given. On the other hand, the type of teacher best suited to such intensive courses will often be hard to find. The concentration itself is a disadvantage, as it is hard for the human mind to absorb more than a limited amount of material in a limited period. There is great lack of time for the demonstrations and visits to installations which are so helpful in study. Moreover, it is hard to get suitable places for the carrying on of the courses, and laboratory teaching is impracticable in the absence of adequate laboratories.

Teaching in a university, whether there is a school of hygiene or merely an active department of hygiene, will admit of the use of a better staff of teachers and a better location on account of university facilities. The courses will be long enough to get results comparable to those in summer schools and other graduate teaching. There will be more demonstration material and more time for the visits above mentioned. On the other hand, there must be a greater limitation in subjects, as even in a six weeks' course with adequate time for the individual subjects there will be none too much time for the essentials of many courses. It is also true that as there are comparatively few universities which offer facilities for this sort of work; there will be comparatively few places where it is available.

Correspondence courses are available for men who can not get away, and a larger number can be reached at less expense. There will also be greater uniformity of teaching, as all the questions can be prepared and examined by the same group. On the other hand, the lack of personal contact and the other well-known disadvantages of correspondence courses make them a last resort or for special purposes.

Fortunately we are not held down to any one of the types, and the most intelligent thing is to utilize all of them under circumstances most favorable for each. Until all posts are filled by qualified men there will continue to be a demand, and even when all full-time posts are filled by such qualified men a limited need will continue, as it is not practicable for the average busy sanitarian to keep up-to-date without the availability of some predigested food.

Speaking from the standpoint of a university teacher, it is the possibility of use of the university which most appeals to me. In many of the best medical schools, we see annual courses for the benefit of graduate physicians who are in the identical condition spoken of as obtaining among the sanitarians. These run four or six weeks, sometimes longer, are carefully prepared, are noted in the school catalogues, and form a definite part of the curriculum, causing the addition of members to the teaching staffs of the various departments involved. Similar courses in graduate public health could be instituted widely wherever there is a school of hygiene or the equivalent, or where there is a department of hygiene with a proper relation to the local health administration. There should be two groups of these courses, involving on the one hand the more strictly laboratory courses, and on the other hand courses of a didactic or conference type with suitable demonstrations and visits. The essential principle would have to be that the number of courses should be limited to the total that could be handled on a thorough basis, with a reasonable amount of time for each. Courses limited to an hour for each session, and really amounting to not more than 50 minutes, must be merely didactic unless the subject and the class are very limited. If the conference form is to be adopted, this is not enough time, as when a subject is abandoned for the day it can not be readily taken up at the point at which it was left, especially if there have been other subjects studied in the interval. For laboratory periods half a day is none too long, and for some subjects more than twice as much can be accomplished in a whole day as in two separate half days.

The results of the present series of institutes will do much to determine what courses will be most satisfactory, but there are certain ones that will form the backbone of any university system. Among these must be vital statistics, which is not receiving much attention in the institutes; epidemiology, including especially the methods of distribution of our ordinary infectious diseases; sanitary engineering, especially as concerns water supplies and sewage disposal, specific infectious diseases such as gonorrhea and syphilis and tuberculosis: child hygiene; food and milk in their relation to health; and administration, which should include general administration (not forgetting finance), as well as the more specialized forms for subdivisions. In addition there should be public-health laboratory courses, preferably in connection with the municipal laboratory with its large material.

It is obvious that it may not be possible or even wise to attempt to include all these in one session, though on the other hand it will readily be seen that the average seeker after knowledge will prefer the plan of electives to that of complete adoption of the whole series.

But if longer courses of this type are to be successfully developed it will be necessary to stimulate them in two ways: (*a*) By education of the political authorities to the appreciation of their value in the efficiency of the administration, with the natural corollary of agreement to leave of absence; (*b*) by financial assistance to the departments undertaking the work. In postgraduate courses it is the custom to charge a fee to reimburse the teachers for their time, as is also the case in summer courses of all sorts and in extension work. In this connection, however, I do not believe that the end desired would be subserved by direct payment to the teachers. It is the usual policy in the present day medical school to make promotion in position and in salary dependent on published investigations, and calls to other posts are usually influenced by the same index of performance. As long as a man is dependent on this for advancement at home or abroad it is not fair to ask the use of his extra time without compensation. On the other hand, it is clear that an addition in pay will not affect this point directly, but will still entail the same loss of time for investigation. If, however, the department is assisted in its budget by such additions as will take a corresponding part of the routine off his shoulders, routine of a type equally well carried on by subordinates, I believe that most teachers in active departments of hygiene would gladly undertake this work for the advancement of public health. The actual details involving a suitable release from routine would naturally vary in different institutions, and it is only the principle which is brought up here for discussion.

Where no regular courses of this character are available under university control, and also for the group who can not get away for as long a time as a month or six weeks, the institute will continue to fill a want. Analysis of the present schedules and conversations with some of the men who have tried the scheme as students indicate that the time is too short and that the concentration is so great that the final effect is one of confusion. One may admit at once that this confusion may readily be removed by a little additional home reading, but one must also admit that this will probably be carried out by the minority.

It has been noted by prominent teachers that the average length of time during which one can keep attention firmly on a lecture is about 20 minutes. The more detailed and technical the subject, the more difficult it is to hold the attention of the class. Accordingly, the more intensive a course has to be, the more difficult it will be for the average man to get enough out of it. One must also keep in mind that among the men who require this additional teaching the average age is much higher than that of the ordinary student and that the mind is consequently less flexible. It may be urged on the other hand that the channels of the brain along certain lines have been sufficiently worn to make the currents of information flow more readily along them, and in some cases this is true. But in many cases the channels have been worn in the wrong places and the information requires a good deal of cross channeling before it can get a smooth flow. Experience shows that courses of six to eight weeks in summer schools for scientific or other subjects are necessary to get the subject across. Courses running three or four days or a week are valuable in giving a general summary of the subject in hand but do not admit of sufficient detail. Most memory is visual, and it is the rare person who has a really good auditory memory. Demonstrations take time, but emphasize the facts taught, and aid in making clear the reading matter which is also a part of the visual memorization. For many purposes a certain amount of laboratory work is essential, and of this nothing can be done in a week.

Inasmuch as a great part of the teaching will naturally be carried out by the local health authorities, it is clear that their position differs very much from that of the university teacher. There is nothing that so clarifies one's ideas as having to impart them to others, so that an institute held in connection with a health administration will not only help the students who come to it but will greatly improve the character of the local knowledge.

Where, in addition to the health officials, university men are used in the teaching, there will be the same question of remuneration. It is clear, however, that there is a great difference between giving three or four or five lectures in the course of a week or so and preparing and conducting a course, and the conditions surrounding each type of instruction would have to be considered.

Correspondence courses will probably be most valuable under State control, where the matters most closely relating to the particular affairs of that State may be emphasized, notably the laws, which unfortunately vary so much. At present the enormous amount of detail which falls on the persons preparing and collecting the examinations tends to confine the courses to commissioners. This still leaves untouched the large and important group of subordinates on whose efficiency so much of the success of the commissioners depends.

Use of university facilities for local health departments.—The greater the intimacy between the university department of hygiene and the local health department, the greater will be the mutual benefit unless, as Ferrell suggests, the university teacher becomes so overburdened with administrative routine as to lose efficiency in both directions. But leaving aside the question of time-division, which will vary in practicability in different places and with different individuals, there is much that the university can offer in the line of extension work without expense or serious trouble. Most of the universities are located in large cities, where there are many health activities and a fairly large staff with diverse duties. The university feels that it has a right to the use of municipal activities, but often holds a quite different attitude toward the other side of the shield.

This is an obvious loss of opportunity. Take, for instance, the library of the department of hygiene. This is usually kept up to date and from the very exigencies of the subject must be of extraordinarily wide scope. If it is to be of value to the department, some sort of catalogue is essential, and this should be available for and accessible to the health-department workers of all grades which can profit by its use. It will doubtless be answered that when they come they are made welcome, but that they do not come. The answer is that there are few who clamor for education but many who will take it if made easy. If the university has any function as an educational factor in the community, it is its duty not only to offer these facilities but to stimulate their use. We have established this principle in Cleveland with such success that various members of the local health department are detailed on certain days to use the hygiene library and to report on their abstracts. The men working along certain lines in the city have also been stimulated very successfully to cooperate in epidemiological and other investigations with students as well as staff members of the school, resulting in a broader interest and closer application of facts on both sides.

It is our plan to stimulate this further by systematically watching the literature for reading suggestions for the health division, and by inviting them to our staff conferences, at which abstracts of the current literature are read and discussed. It is appreciated that local conditions have marked bearing on the practicability of all this scheme, but I wish to emphasize that if it is possible to work it out in one place it can not be said to be impossible of accomplishment.

Training of technicians.—As noted earlier, a good technician is one of the props of every department in which laboratory work is a large factor. Moreover, trained technicians are few and difficult to find. The average technician, and the better than average ones also, are for the most part accidental in their development. As a result they have a training which is dependent in character on the knowledge and interest of their immediate chiefs, who rarely have any time for the development of a background for them. There are constant requests from persons who desire some such training, and it is practically impossible to offer courses which will cover the ground. A plan is under consideration in Cleveland at present which is based on the principle of apprenticeships. Through the fact that the municipal laboratories are intimately connected with those of the medical school, there is a chance for an experiment. Applicants will be passed around in the school and city divisions, assisting in the various technics, with the idea that they will be of sufficient assistance in the routine which they must necessarily acquire to offset the trouble of the actual technicians and laboratory workers in teaching them, Whether this will work out or not can not be told, but it appears to us an experiment worth the trying.

Summary.—The problem of the partially trained sanitarian is of immediate importance, and will continue to be a problem for many years.

The possibilities for his instruction lie within the range of correspondence courses, brief institutes, and longer postgraduate courses analogous to those in medicine.

While correspondence courses and institutes have a definite and valuable place, the best results will be obtained from the longer courses of six to eight weeks.

In all cases encouragement is needed in order to obtain adequate leave of absence for those needing the work.

Whenever the university facilities existing in the department of hygiene are made available to the staff of the local health department it will result in mutual benefit.

DISCUSSION.

Dr. Eugene R. Kelley:

I was somewhat puzzled as to the basis on which this program was made up at first, but finally in retrospect one gets the idea. I was to represent these political health officers who have so frequently been mentioned. And here we stand. We are like Topsy, "We just growed." There are hardly any of us who are trained men; that is, technically trained in public-health work.

I hope that no one will get the impression that I am at all antagonistic to the spirit and intent of this meeting, and I think it is a wonderful thing to get such a group together and to discuss common problems and ideals. But there are several matters about which I would like to say a few words.

Doctor Freeman has mentioned the fact that of the health officers in all the States and large cities of the United States 101, or 84.2 per cent, are physicians without public-health training, and that 4 out of 6 men who have had no technical training at all are located in Massachusetts. I am going a step further and expose our whole situation. Doctor Freeman did not approach anywhere near the truth. As a matter of fact, there are 65 cities and towns of over 10,000 population in Massachusetts, approximately 10 per cent of the whole number in the United States, and in only about 5 is there a full-time medical officer, with public-health training. You can see what a hopeless situation we are in in Massachusetts, and according to all the rules of the game we should have no pride in past achievement nor any hope for the future. But that does not tell the whole story. The Massachusetts system provides for a board of health with an executive officer, who is often an untrained man and yet who has learned a few things about the practical administration of public health. He is appointed under civil-service regulations. Usually he has a few of the best type of medical men on his board—serving without pay. This may be the reason why some things have been accomplished in Massachusetts.

I do not think this is an ideal arrangement, but just the same, any system which can be made to work even though it does not meet the views of the best thinkers deserves consideration; and those of us who are of the common or garden variety of health administrator, if unfortunately we have not had the desirable special training, still we work and live and labor. I suppose we have graduated from the university of hard knocks in public health.

As I am a strong believer in public-health education, just as strong as any of you, I hesitate from seeming to criticize all the time. Nevertheless, propaganda for public-health education can work two ways. I once had the experience of preparing for the most influential newspaper of a State a perfectly splendid article in a tone of righteous indignation, voicing my disapproval of the very benighted and shortsighted attitude of the legislature in not increasing the appropriation for health work. The article was published and I got all the sympathy of the public-spirited people of the State. But not only did I not get an increased appropriation, but I got the former amount cut 50 per cent because the men who were most reflected upon were the men who had the votes. Many times a man comes in with an idea which looks pretty good but involves drastic criticism of present methods. And then I think of that time when I had to take a small young health department and nurse it along so it could grow up again to the place where it was before my ill-advised interview was published. Then I usually decide to refrain from rushing into print. That is the kind of training that you can never get in a school of public health. Probably these lessons are more important than those you can learn in a school of public health.

In the next place, I want to speak a good word for the system of training by apprenticeship. You can take people who have never gone beyond the common schools and employ them as technicians and inspectors and you can gradually impart to them in a series of practical talks and demonstrations the facts they most need to know for this work, and they can be employed in a practical and useful manner by a public-health department.

Moreover, we have, I think, rather overlooked emphasizing the public-health "sense" and have put too much emphasis on the ability of special training to do it all. I feel with Doctor Abbott that there are some inherent qualities that we can not get from schools. Conceding that it is desirable for the general health administrator to have a general medical education and to have a full course of public health, according to my system of grading there would be only five or six hundred points on a scale of 1,000 that could be credited in this fashion. The four or five hundred points left never would be covered by any of this education; they consist of more or less inherent qualities. These qualities can be encouraged to some degree, but can never be created. We must do all we can to aid in teaching public-health students how to live with people and get along with people.

We need the men and women of special education, and still the enthusiastic man who is untrained may be like those who "rush in where angels fear to tread" and yet win out. Anyone in administrative work will realize this. I can recall instances where I have broken useful ground in a new field that I might not have had courage to enter had I understood all the facts. I agree most heartily that we need the special knowledge. But more than knowledge we need faith—faith in the people and faith in the cause, the faith to try out something that has never been done, but which may be successful to an astonishing degree in promoting health.

A word about short courses. They are one of the things I think we can well use in developing health workers. The correspondence course has its place, but the correspondence course is a last resort—a very sad last resort. I do think we ought to arrange short courses in something the same way that the courses are arranged in agricultural schools for the plain farmer. In these courses an arrangement is made so that if a farmer wants to find out how to raise chickens he goes for two weeks, or if he wants to learn how to care for milk he goes for another two weeks. There are advantages in this method, and it may be used with some of our partially trained men that are already in the public-health field. Doctor Crumbine is going to tell more of the possibilities of this method of training.

There is one other subject that rather puzzles me. That is the question of keeping employees in the health department in a student attitude of mind. Doctor Perkins touched upon this problem. It is one of the hardest problems that comes before anyone responsible for the running of a health department.

Finally I wonder after all just what we are to train men for in these new schools of public health. Personally I must take issue to some extent with my friend Professor Winslow on the remarks he made last evening. I can not look forward with any enthusiasm to the British system as an ideal for which we should strive in this country. I can not look forward with pleasure to the possibility of 25 or 33 per cent of the medical profession being employed by the State. I have not lost faith in my profession. I think it is more or less the fault of those who are interested in preventive medicine that they have not succeeded in interesting the doctors. I deprecate efforts to get more physicians working for the State. That is the British system. I believe that Sir Arthur Newsholme himself did not feel that it is an unqualified success and that it should supersede our ideas of private medical practice. I hope I have made this point very, very clear.

Dr. S. J. Crumbine:

Owing to the lateness of the hour I am not certain but that I would best serve this conference by announcing that luncheon is served and adjourn. I wish, however, for just a moment to speak concerning the training of the part-time medical health officer, to direct your attention toward our immediate needs. This conference program has been taken up largely with the future education of sanitarians. I must express my disappointment that more emphasis has not been placed upon that other phase of the subject—education of part-time health officers—because there are more of them. The Public Health Service has recognized that need in the establishment of public-health institutes that are now being held throughout the country.

It may be permissible for me to recite briefly the history of Kansas along this line. Eleven years ago we established the first school of health officers, as we called it. It was based upon the very obvious need of uniformity in the enforcement of regulations; but more particularly to develop the idea of modern public-health work as contrasted with the old public-health ideas with which we are familiar.

The first attempt was only fairly successful. Some 25 or 30 part-time health officers—we had no full-time health officers in Kansas at that time—assembled for this week of instruction. As our instructors we had sanitarians who had been developed in the school of experience, Doctor McLaughlin, Doctor Eugene Kelley, Doctor Freeman, and others who had risen to prominence as health officers. We made the attempt in this brief week of instruction to develop the idea of the social responsibility of the practioner of medicine—because they were all practitioners—to develop the new relation between the community and the practitioner and to convey over to him something of the new methods and procedures in public health. About the third year, in order that we might secure a larger attendance of our 115 part-time health officers, we conceived the idea of devoting the forenoon of each day of the week to clinical instruction in medicine—a sort of brief postgraduate course, purely as a lure for attendance. We were certain it would be of advantage to them as health officers. That was very successful, and we have had as high as 105 county health officers registered for the course. It has been held annually through the intervening 11 years.

This course has accomplished much good in this, that it has to a greater or less degree developed the modern idea of public-health work in the mind of the part-time health officer, who has in turn handed it back to the community. We should also keep in mind that the average intelligence of the community concerning public-health affairs is usually conditioned by the public-health intelligence of the local health officer. While your program has been very largely devoted to the development of the highly trained man, it seems to me that we should begin working at the other end of the problem from the grass roots up. Unless we can take these part-time men and educate them in modern ideas of public health and their relations to the community, we have very great difficulty in imposing the highly trained specialists on uneducated communities as health officers. Particularly is this true in the present economic situation. There is scarcely a county in Kansas that has not organized an anti-tax league, and in several of these counties petitions have been circulated by the tax reductionists to dispense with the health organization, purely on account of high taxes.

But I want to make this observation, that growing out of this 11 years of instruction we have attempted there have been three county units developed simply because we have been enabled to stimulate the interest of these health officers in a public-health career. They have greatly improved the character of the work, until the community has accepted the full-time health organization. Three of these organizations have been the outcome of these years of work. In not one of these three counties has a petition been circulated for doing away with the full-time health organization. Unfortunately, it is in the other counties on which we have put pressure and in which the State has assisted in putting on a program that the petitions are in circulation.

I insist, therefore, that we give greater attention to developing the idea of working from the grass roots up. We have by reason of these brief schools of instruction uncovered promising material, men who have been interested in public health and who have taken up a public-health career. Many of them have now gone to schools of higher learning and finished their training. Unless we use this slow process of evolution and train the community to the idea of public health, unless we give attention to this part of the program, rather than increasing the pressure from the top down, I fear we shall have a difficult task on our hands. I plead for the part-time medical officer who gained his knowledge in these brief schools of education, inadequate as they may seem to be, to the end that our own people may be educated to modern public-health views.

AFTERNOON SESSION, MARCH 15, 1922.

REMARKS BY THE PRESIDING OFFICER.

DR. FRANK J. GOODNOW, *President Johns Hopkins University.*

I do not know whether to consider it a discrimination or a privilege that certain limitations have been imposed by the program upon the chairman of this session. We are to discuss specific questions which may have developed at the preceding sessions. I have here a list of questions that was handed me by one gentleman, and I should be glad, if any member of the conference wishes to hand in any other questions, to bring them up for discussion.

The first question to which attention was directed is: "How may the school of public health provide for its students experience in practical public health work?" I think from our experience on this subject that we should frame it in another way, and that is: "How can the health departments in which the practical work is done cooperate with the schools of public health in providing opportunities for practical work for the students?" We all, I imagine, consider that this practical work is an absolutely necessary part of the course.

I might say that the intention of those who have been directing this conference is that this round table discussion shall last for about one hour. This is the question which is before you: "How may practical opportunities for field work be provided for the students in public health schools?"

VI. ROUND TABLE.

QUESTION: HOW MAY PRACTICAL OPPORTUNITIES FOR FIELD WORK BE PROVIDED FOR THE STUDENTS IN PUBLIC-HEALTH SCHOOLS?

Dr. Haven Emerson, Cornell School of Hygiene:

May I make a suggestion? If we think of this question in the terms that we would in the practice of medicine, we are really considering how we can teach students of health administration to make diagnoses and to arrive at a proper prescription for a situation and to apply treatment. Unless we are going to duplicate the errors of medical education, we shall have to have at the service of the teaching institution a community to study, to make the diagnoses upon, where students may follow out results of treatment and learn their errors. I should say that it is as indispensable for a school offering a course in public health to have a section of the city and rural community to study for their laboratory, their training ground, and their clinic, as it is for the university medical school to have its hospital to teach diagnosis of the individual sick. So I believe that the universities should at once busy themselves by making affiliation with the health officers of the city and State in which they are located.

Western Reserve University has what is known as the university district, comprising one-eighth of the city of Cleveland. You need at least 100,000 people to have an experiment station to study; you can not indicate or get intelligent results in the incidence of communicable diseases unless you have that number. If a community, as is usually the case, has an insufficient staff of workers it can be supplemented by the students who are attending the schools. They can be of assistance in the field in making periodic examinations, in making immediate diagnosis of suspected communicable disease, and in studying conditions of industries in the districts. It will be possible to contribute from the school to aid the insufficient force of public-health nurses.

This relief might be the contribution of the university. On the other hand, the health officers would be willing, presumably, to see that in that particular district they assign those who are capable of teaching and urging every step incident to technical education. By this capable administration the health department would have the benefit of that particular area for a degree of study and a degree of skill which would be difficult to command from the salaries or appropriations made for most States or cities.

Therefore, I believe that the first move in establishing schools of health is to provide patients for the student to study sickness as it occurs in group relations. The quality of technique employed is as definite as that required in the examination of the individual. I do not think a school ought to offer a course in public-health administration unless it is able to give a field for practice—call it apprenticeship or whatever you wish—a field of practice similar to what the medical student has offered to him in the hospital.

Dr. William Charles White, National Tuberculosis Association:

I want first in discussing this question to say a word of appreciation of the Public Health Service in calling this most notable group of men together. It is the beginning, I think, of a gradual breaking down of the pride of the Service and the beginning of cooperation with a large number of agencies dealing with this public-health question. The Public Health Service is the only legal correlating body in the United States. There must, it seems to me, emanate from it all the correlation and influence which is backed by law in bringing about this cooperation.

If there were any resolutions to be offered by this body, I would suggest this, that the Public Health Service (which is carrying on, as Doctor Vaughan mentioned yesterday, an enormous number of intensive public-health activities of tremendous value to the active students who are now in public-health work in different cities and State organizations) take students, in any number that they see fit, at the expense of the organization which sends these students; that is, either State or municipal health department or university. The workers would be sent into the active fields of work for intensive study and possibly at least two months' practical training. It is a very common thing in business life for an organization to carry upon the pay roll its likely members and to send them out for intensive study. This assures a much more efficient type of service than they would be able to give by experience gathered within their own organization. It seems to me that not only the United States Public Health Service should do this, but also many of the State organizations like the Massachusetts State Department of Health, which is among the earliest and most efficient in the country, should offer such intensive courses to students who are on the pay rolls of different health activities in this country. It only needs such an offer to attract a large number of paid students.

I was very much impressed with Miss Goodrich's statement this morning that the thing we actually need to gain is some such help now. We have an unlimited field for the present graduates; very probably we could give them a number of practical things which would assist the students (for they are all students) in public health to actually get help to those who are suffering from conditions which need to be corrected at the present time.

I am probably not talking exactly to the point, but the question was brought out in Doctor Jordan's paper—the necessity for a supply of students. Public-health institutes and public-health departments of universities are, of course, not serving their full purpose unless every bench in each school is filled. The overhead charges would demand that. Therefore, it would seem to me possible for the United States Public Health Service, as the proper legal correlating body in the United States, to send through the medical schools and universities lecturers explaining to the students the field of public-health work. No one knows better than General Cumming how hard it is to take on new work now, due to the economic wave running through Congress. But at least this question of health might, if we all join forces, be realized from the economic viewpoint. I feel that a unity of purpose and an effort to help the United States Public Health Service, with the new spirit that is in it, to get the funds necessary to carry out this correlating effort throughout the United States should be at least one of the results of this meeting.

The origin of funds is the National Congress and the various State and municipal legislatures. I would further suggest that request be made to these bodies to have presented to them by the most powerful speakers that can be drafted in the various parts of the country in and out of the universities the program of a correlated system of public health for the United States, so that in time they will be ready as our knowledge advances to appropriate funds necessary to clear our borders of all devastating illnesses which can be removed from our midst.

Dr. William F. Snow, American Social Hygiene Association:

The Public Health Service has always, so far as my experience goes, held its laboratories and the educational aid of its staff open to the personnel of the health departments and others who could come for short periods of observation or instruction. As long as the health officer or the individual can finance himself, he will find, as I have found, these facilities of the Public Health Service and the Hygienic Laboratory and other Federal departments cordially extended to him.

Some years ago I devoted the presidential address of the State and Provincial Boards of Health to the question of exchange of appointments, feeling that I had a solution for the training of personnel of the State boards by from three to six months' service with another department. Particularly, I tried the plan out with the State of Louisiana, to which State I wished to send my men for experience in tropical diseases. We ran into the difficulty that most of the States can not pay the salary of a man who is outside of the State. The Public Health Service, which was handling plague for us in San Francisco, was very glad to have the opportunity to train men from Louisiana, where they were apprehensive of what might happen if plague broke out, but it was impossible to negotiate the legal side of paying the expenses or salaries even of the persons to be exchanged. Public opinion must change our machinery for paying salaries so that such cooperative plans could be carried out. This question involves the education of public opinion to see the importance of this business principle, and I believe it can be brought about.

Dr. H. R. Carter, United States Public Health Service:

I think I can say a little along the lines on which Doctor White just spoke. From 1914 on, the malarial division of the Public Health Service working in the South has taken as its assistants from State health officers men whom they, the health officers, wish to have trained for malarial work. At the time stated there was no one in the United States who knew anything of field investigations of malaria or field control of malaria except Von Ezdorf, Le Prince, and myself. We first asked the State health officer of Virginia for an intelligent, well-educated man, who could work with us, and who would be paid by us and returned for their use as a malaria control man afterwards. The same proposition was made to North Carolina, South Carolina, Alabama, Tennessee, and, I think, Texas. We have had in all some 12 or 15 men who cost the State nothing to train. They were as useful as any other men to us, intelligent and educated, and we paid them as sanitary assistants, keeping them from one to three years until they were fairly skilled in field malaria investigations and field malaria control. Most of them have gone back to the States and are handling this problem for the State.

In addition, we furnished, during the last few years, engineers working on railroads at our expense as malaria control men. The railroads, finding the work extremely valuable, placed them on their own pay roll, and thus enabled us to take on new men for training—not a great number, but I think it is fair to say that from 15 to 18 of such men have been trained by Public Health Service men working with us under a salary, with no expense to the State, and have later on gone back to their States and to the railroads. We have trained them, and they are now doing work which they could not have done without that training.

Our malaria field service, then, has been a training school in which men selected by the State health officers have received practical instruction in the field investigation and control of malaria, which they are now using in the service of their States. It is fair to say, counting those men used in malaria work during the war and who still continue in such work, that we have now probably 50 to 60 men, mainly civil engineers, who are fairly well trained to take charge of malaria control work—some of them extremely well trained. And the number is increasing. Nothing that we have done has been more fruitful in advancing the malaria work in the United States.

Dr. G. B. Young, United States Public Health Service:

The possibility of the cooperation of municipal or local health departments in the work of educating health officers has not been sufficiently appreciated. So far as I know, the first real attempt to do anything of the sort was made by Doctor Evans, who as health commissioner of Chicago organized in his department a school of sanitary instruction. There was an incidental return (financial return I mean), because by this incorporation he was enabled to mail publications of the department under the provisions of the law in regard to the publications of educational institutions. But Doctor Evans did not succeed in getting very many people to take an interest. Only a few students attended. Under the subsequent administration the plan was developed quite a good deal and a pamphlet was published by the school, setting forth the courses which were available. These included courses in field work under the bureaus or divisions of communicable diseases, child hygiene, school inspection, sanitation and ventilation, and laboratory courses in connection therewith.

As a matter of personal experience, I was rather surprised to note that many would come for three months and pay their own expenses. We like to think we did them some good.

The schools or courses in public health teach a great many things concerning the control of communicable diseases and the conduct of other health department activities, but teach them almost entirely from the didactic point of view rather than the clinical. The things that schools do not usually give are the practical work of the housing inspector, sanitary inspector, food inspector, milk inspector, building inspector, etc. It is therefore absolutely essential for the man who is studying in public-health schools to have the advantage of instruction in the field. The best way for him to get it is through the larger health departments, not only the municipal, but also the State departments. If the municipal and State departments would get together and provide certain facilities for instruction, agreeing amongst themselves what they could do and how they would divide the work up, and then offer their services to the schools and universities in that particular area, the possibilities for good are practically limitless.

We need men thoroughly trained in the practical technique of field work and in the attitude which they should observe in their relations with the people with whom they come into contact, and these things, especially the latter, can best be learned under the conditions of actual service.

Dr. W. H. Welch, Johns Hopkins University:

It seems to me, Mr. Chairman, that this is a matter of vital importance. The practical work in the field occupies precisely the same relation to the training of students in hygiene as our hospitals do to medical students. The fact that the need for this training was not recognized in medical education for so long a period is one of the great causes of the difficulties which we have had in bringing about the proper relationship between hospitals and medical schools. It has been one of the most difficult things to perfect.

The field work that is to be furnished in public health along the lines just indicated is, of course, very important. At Johns Hopkins we require that there be at least three months' practical training of this kind. I wish to express here our very great appreciation of the cooperation on the part of the municipal, county, and State boards of health, such as the Public Health Laboratory of Doctor Wadsworth and Doctor Biggs, of the New York State Health Department, in taking our students for this period of time. But I do not think this is enough; I think we need a relationship to the practical work in the field, quite comparable to that of a first-class teaching hospital to the medical school. That is, there should be right at the very door of the school of hygiene an area for public-health training (two areas are desirable, urban and rural). Just as you are justified in doing certain things to a hospital to adapt it for teaching the medical students, so you are justified in supplementing the work supported by the taxpayers. You are justified in establishing certain conditions in order to make it better adapted for the training of students. The ideal arrangement in my judgment would be to have an urban area, say of from fifty to sixty thousand inhabitants, under the administration of the school with the coöperation of the city. I am quite sure they would welcome a rather superior person to have charge of the work in that area—a supervisor. There should be a school for public-health nurses, attached to which there would be a supervisor having charge of a large number of public-health nurses. Just as a teaching hospital is used for the purpose of making certain demonstrations, experiments, studies, and a collection of certain data, which you could not expect the ordinary State or city health administration to spend the taxpayer's money for, so in this area demonstrations and studies would be arranged. We have something of that sort started in a county in Maryland, thanks to the cooperation of General Cumming and the Public-Health Service.

Like everything else, the success of such a venture depends upon the quality and character of the man put in charge. Of the two types which have been discussed here to-day, the mixer and the man who knows, I think the latter is preferable, but there is no reason why you should not have both. Success depends to a large extent upon the quality of the man in charge. The school of hygiene contributes some $6,000 and the National Health Board perhaps $10,000, I am not quite sure. The local agencies are all stirred up—the local Red Cross, the public-health association for the county. There is a wonderful spirit and an aggressive movement. We will be able to demonstrate the effects of good public-health work by the results. There is already a marked reduction in the infant mortality, and a great improvement in the control of typhoid fever. It is being run along lines that are full of suggestions for the practical worker. There is no use making experiments of this kind that are idealistic and impracticable.

Now, Mr. Chairman, I just wish to urge that a first-class school of hygiene should have attached to it and at its door a training area, which is just as necessary for students of hygiene as is the teaching hospital for students in schools of medicine. You can not expect the money that is available for the municipal and State boards of health to be available for all the purposes for which you would use such an area as that. I also feel that where such areas can not be secured elsewhere the university group itself may be used. There is no reason why we should not have in connection with the university medical school a good health department with a relatively small expenditure of funds, an excellent training area, and to have numerous such areas in different parts of the country. I wish to appeal for the establishment of areas of this kind, which are absolutely an essential part of the practical and thorough scientific training of those who are coming into this field.

Dr. Otto P. Geier, Cincinnati Milling Machine Co.

I feel that this organization might well consider just what value industries might have for the training of health officers. Here we have in a small unit—perhaps five to ten thousand people—almost all the problems of the large city health officers: Food supplies, milk supplies, water supplies, and sewage disposal. In addition, we have the human element, which has been discussed so much and which is often the main difficulty to the health officer. Here you have a group which the leader in charge of industrial health work can study at close range. He sees the problem in all its complexities and yet all its simplicities. I believe that in the training of the health officer it might well be considered necessary that some time be spent in a well-organized industry, where he may see the problem almost in its entirety.

Besides the human equation entering into the industrial work, there is the contact with men and the development of the ability to sell health to the average man. After all, this is a thing that the health officer is going to have the most difficulty to comprehend—how he may get his message of good health and its value as actually applied to appeal to the common man. If we can get this matter of health across to the common average man, then we also clear up that question which Doctor Goodnow spoke of yesterday—the necessity of recognizing that health is, after all, a political problem. We can not impose any highbrow element upon average people.

In conclusion, this training is necessary in order that the average health officer may see his problem in all its entirety and that he may acquire this vision of the whole problem and its interpretation to the common people. As doctors, we forget that we preach from an academic viewpoint too much, and we do not realize what powers lie within the physician to interpret public health to the masses. In Cincinnati in 1906, when we were up against the worst political situation in the country, when George E. Cox held the county in his grasp, with only three or four doctors taking up only one health problem—they not only secured for Cincinnati the foremost health board of its kind in the country but also one which has given us a health department which is efficient. By its help we were successful in getting rid of the incubus, George E. Cox, and his political system.

Let me repeat, do not forget that health officers in industries are a tremendous factor in public-health work and that by placing a large number of health officers in industries in the community a tremendous force for public health and for the training of public-health officers will be created.

Dr. A. T. McCormack, Kentucky State Board of Health:

We have heard a great deal about what is going to happen at the start but very little about the road and trail and path that leads to the head of the hill. It does not make any difference whether it is in New York, Philadelphia, or Boston, with their great health departments and excellent surroundings, or whether it is out on the prairies, the plains, the mountains, or in the hills, it is the fellow who is at the end of the trail that we have to reach with the lessons of good health and good living, as well as those who are more favorably situated. It is easier to reach him because his head has not been filled with deadwood as have those of us who have had greater educational advantages. We have during our collegiate years gotten to a large extent practically all the knowledge we can ever learn. Some of us while at college devote some time to athletics and so we still have an opportunity to learn. [Laughter.]

I do not for one moment discount the tremendous contribution to the future of our complex civilization made by the great institutions of learning. I believe that to these institutions we can not contribute too much in time, money, energy, or thought. I would not for a moment assume in any sort of way to feel that we are doing nearly enough for them. But at the same time, recognizing the basic health ignorance of our public, we are compelled to provide the kind of health officer who can speak in the vernacular and transmit the things our leaders already know in science.

We want to remember a thing that we have forgotten in medicine—forgotten almost entirely—that the important thing for the fellow who is sick is the art of medicine, not the science. It is a matter of comparatively small importance to the individual what a person may have died of or what he is ill with—that is science; the main thing to him is that the man who is going to be in charge of him shall know what he is likely to have, how to prevent it, and how to cure it. He does not care a continental about the name of the thing which he has. What we need to-day in educating health officers is education in the art of health officering. If we are going to emphasize only one or two things, let us emphasize the question as to whether he can translate his knowledge into action with the individual—translate it into action for those of us who do not know. If he can write big so that he who runs may read, then he has learned the lesson that can be translated to the people. It is indeed a matter of importance that we have this type of man. The greatest research man should be able to talk in the vernacular, so that he can translate his information into action to those with whom he has to deal. This is the most important part of our problem to-day.

In Kentucky we have established a school of public health. I think we were extremely fortunate in the fact that it was established under rather close connection with the State health department. I think it was extremely fortunate that it was organized and managed in the beginning by a graduate nurse who had been trained during that period (by one of the greatest practical nurses, Miss Noyes) when nurses were taught all the science they could get into their system while they were being taught to work with their hands and bodies. Our main objective is to try to make practical talks to our applicants and to make ourselves understood when we do talk. In doing this, arrangements have been made so that health officers, health nurses, sanitary inspectors, technicians, and other health workers can attend.

I think we have talked about terminology more than its importance demands. I do not think it makes much difference what you call workers in the public health field, but my own view is to put into them something that makes people want to hear their story.

QUESTION: WHAT SPECIFIC STEPS MAY BE TAKEN TO BRING BEFORE COLLEGE STUDENTS IN GENERAL AND MEDICAL STUDENTS IN PARTICULAR THE OPPORTUNITIES FOR SERVICE IN PUBLIC-HEALTH WORK?

Dr. George M. Kober, Georgetown University Medical School:

This seems to me a very important question in view of the fact that Professor Jordan's analysis reveals that there is a great deal of ignorance on the part of medical students as to the possibilities of a public-health career. From my viewpoint it ought to be a very simple matter to stimulate interest among students when I recall that the leaders in public health—men like Vaughan, Welch, and Edsall—as deans in medical schools were in a position and undoubtedly did stimulate interest and enthusiasm among students in this subject. I am sure their own precept and example have done very much to attract what I call men with human sympathy into preventive medicine. I am confident that the subject of hygiene was not relegated to inferior rank in their schools. Personally I have always managed to have at least 100 hours for this subject, and have had no difficulty to persuade the professors of chemistry, pathology, and bacteriology to give a good deal of attention to sanitary subjects and prevention. So there is a way to secure attention, and the best way, I think, would be if we could persuade our medical faculties to make their professor of hygiene also the dean of the faculty.

Dr. William Keiller, University of Texas:

As a representative of one of the medical schools in Texas, 24 hours from St. Louis and 36 hours from everywhere else, it seems to me that if we can keep this matter of opportunities in public health—not the Public Health Service alone (which we in Galveston appreciate, especially since we have been visited by plague)—if there could be some means to keep this matter more or less continuously before the minds of students—and, incidentally, faculties—it would be worth while. I have wondered whether it would be possible for the Public Health Service to have printed some sort of pamphlet—a pamphlet with rather attractive outside with a short heading, and, if desired, immediately below that: "Please display this continuously in the library." Such a pamphlet should set forth the opportunities in the Public Health Service, the opportunities in city and State health work, the present schools which give special courses in public health, and so on—important matters for the continuous information of students. Something along the same line could go to nursing institutions or to our academic institutions, where so many young women are taking academic training and are hungering for public service. If this could be kept continually before the minds of the students, I believe it would get a reaction now and then and get students to thinking along those lines and call forth occasionally really good men and women for this class of service.

Dr. Donald W. Davis, College of William and Mary:

Most of the suggestions that have been made for recruiting for the health service have been suggestions which would draw prospective candidates from medicine. Now, as a representative of a college, I want to suggest that we should take into account the losses that are now occurring among those who might be candidates for degrees in medicine or in public health. We all know that the long period which is required for preparation and the great expense of medical work discourage many men who might go into this field. I am not speaking of those who are discouraged by reason of their own ability, but the time and especially the expense discourage many first-rate men.

The field of public health has one great advantage over the field of medicine. A medical man or a man who might become a doctor of medicine is of no use in the line of medicine until he has had at least two years of college work and at least four years of medical school work. Those are minima. On the other hand, is it not true that a man may do creditable work for the time being in public health after he has had at most four, possibly even, as a technician, three years of work, provided his work has been properly arranged? That will result, I think, not in depleting the number going into medicine and completing the medical degree, but rather adding to that, because this is a field which will enable many a man who can not go on with his medical work for the time being to get into some line which will eventually permit him to complete his medical training.

I hope that the way may be opened for men of high promise and ambition but of limited financial resources to go into various public-health services for which premedical and partial medical training may have fitted them; and that these men may be encouraged thereafter to complete their medical and public-health training.

Information as to openings for such men, judiciously spread among the colleges as well as the medical schools, would do much to attract men of good caliber into the field and save valuable recruits to medical and public-health work.

Dr. Charles W. Stiles, United States Public Health Service·

I would like to state that after 31 years in public-health work I consider that the greatest opportunity before the student of or worker in public health is that of making sacrifices; to do good for others. There is no use of any man's entering this field unless he is prepared to make personal sacrifice. No man should enter public-health work with the idea of any grand opportunities before him. They do not exist in this country. There is only one opportunity that does exist, and that is the opportunity of personal sacrifice. If he is not prepared to make this sacrifice he had better keep out, because he is not going to be a success.

Let us recall that the type of public-health officer that is demanded by a locality and that can obtain a job and hold it can be expressed mathematically, namely: Multiply the density of population per square mile by the average per capita wealth. That gives you the money value of your locality. Therefore, it gives you an indication of the amount of money you can expect for your health department. If you have a dense population with a large average per capita wealth, that locality can afford to pay a first-class health officer. If you have a sparse population with a low average per capita wealth the locality can not afford to pay a first-class health officer. That will represent the money that can be put up. If we carry out this simple mathematical problem, we will find that the average county in this country can not afford the type of health officer we have been talking about here. The type of health officer has got to be the man who is willing to make a sacrifice. The one opportunity is to make personal sacrifice and that is the only positive thing we have to look forward to.

Dr. Louis I. Dublin, Metropolitan Life Insurance Co.:

Almost as important as the health officer himself in a constructive public-health program is the development of a strong intelligent public sentiment interested in his plans and cooperating with him in carrying them out successfully. The main difficulty which besets the path of the health officer is the lack of an alert and educated body of citizens who understand what he is driving at and hold up his hands at every turn. At present, the mass of the people remain inert and indifferent. Making provision for the formation of an enlightened group of citizens organized for effective service would mark a really progressive step in public-health work.

In what portion of the community shall the health officer look for his recruits? There are enrolled in our colleges about 200,000 men and almost as many women and this number is steadily increasing. Hence every year we have a large number of graduates entering community life to become leaders in the professions and in the fields of business, finance, and social service. It is this group of young people whom we must seek to interest in health problems. And in order to do this most efficiently it is important that those directing the training and education of these boys and girls should themselves be roused to the value of health work. In the colleges we can prepare our future health workers for their tasks and, even more important still, we can create an intelligent and articulate public opinion. Much of the present curriculum can be utilized for this purpose. Almost every college for boys and girls has a department of hygiene; a gymnasium; courses in chemistry, biology, bacteriology. But each department and course is to-day independent of the others. There is no attempt to merge all this diverse information into one connected and coherent whole. Moreover, the practical bearings of the various scientific studies are overlooked and the theoretical knowledge is not linked with concrete problems of sanitation, hygiene, etc.

The teachers do not appear to realize the importance of training students to become forces in health work. When this aspect of the teaching problem is called to their attention, however, they become interested in the new point of view and are ready to correlate their courses with this purpose in mind. I had occasion a year ago to look into the question of the education of young women, and I found that while there was a good deal of work along health lines being done in our colleges, the courses were not related one to the other. But I found, also, that it was easy to interest deans and faculties in these matters, and that they were quite ready to cooperate and modify the curriculum.

Here is where the Public Health Service comes in. It should develop a curriculum outlining courses of studies based on the instruction now being given in the colleges and make available to all the universities of the country an outline of this program. These studies covering a period of three or more years would result ultimately in the crystallization of the health movement and the formation of a community group in each city and town proficient in health problems and administration. Graduates of our colleges will then be equipped to function efficiently in any private or public capacity.

as the leaders of Red Cross movements, directors of nursing associations, and in the many other activities of a progressive, social nature. Public opinion thus aroused would serve as an advisory body and be able to support intelligently the work of the health officer. Moreover, you would have a far larger number of boys and girls in the formative period of their lives interested in community well-being, and it would be reasonable to expect that a not inconsiderable proportion of them would wish to enter the field of public-health work as a profession. Proper provision for public-health instruction in our schools and colleges would thus serve in a dual capacity; first, in increasing public interest and support and second, in actually increasing the number of candidates for public-health positions.

Dr. Robert Wilson, Jr., Medical College of the State of South Carolina:

Dr. Vaughn has made the remark that the atmosphere of medical colleges as a rule is antagonistic to public health. I fear that he is right. At any rate, my observation has been that health officers often meet opposition instead of sympathy and cooperation among the physicians with whom they have to work. Recognizing this in South Carolina, we have made an effort in our school to correct this situation and for several years past a systematic course not merely in hygiene but in public health has been given by the State health officer, Doctor Hayne, as an essential part of the course in medicine. This course includes the problems of health administration, a general consideration of vital statistics, the legal and the normal obligations of the physician to the community as a custodian of health and disseminator of health knowledge. I believe we are beginning to see some results in the development of a truer conception of his responsibilities by the practitioner and of a better spirit of cooperation. All of our schools can not give the courses in public health which have been suggested here yesterday and to-day, but every one of our schools can do what we are trying to do, and I believe it will be an effective means for aiding health administrators in carrying out their work.

Dr. John M. Dodson, University of Chicago and Rush Medical College:

I wish to say something in reference to the education of the medical student preparing for general practice. I believe that the change in the curricula of the medical schools to which Doctor Abbott referred this morning should have as one of its conspicuous changes a much larger emphasis on preventive medicine. While something can be done by the expansion to some extent of the present courses on hygiene, bacteriology, and the like, the real solution lies in a change in the attitude of the clinical teachers all along the line. I would have every clinician presenting to a class of students a case of typhoid fever ask as the first question: "Why did this patient get typhoid fever?" "Who was responsible?" "How could it have been prevented?" "What should the physician do in the community to avoid this sort of thing?" When a surgeon presents a case of infected wound of the hand from an industrial establishment he should ask: "Why did this man's hand get infected?" In other words, if our clinical curriculum is presented from start to finish with a strong emphasis on the possibilities of prevention we shall be teaching a generation of medical students how enormously greater are the possibilities of prevention than the possibilities of cure, and out of that group there will be little difficulty in getting a sufficient number of men to take up that special phase of preventive medicine—public hygiene.

How is this to be brought about? Only by addressing the medical faculties themselves. I should like to see the health authorities approach the medical faculties of about half a dozen or a dozen of our leading medical schools and discuss this important problem as a preliminary to the reconstruction of their curricula, which is just now impending.

VII. CONCLUDING ADDRESSES.

THE UNIVERSITY OF THE FUTURE—A RECRUITING AND TRAINING CENTER FOR THE PUBLIC-HEALTH PROFESSIONS.

DR. RAY LYMAN WILBUR, *President Leland Stanford Junior University.*

When I came on to this conference with rather minute instructions given me by my friend the Surgeon General, I had a fairly good idea of what I wanted to say. But I have sat here and heard most of my ideas presented by others until I feel very much as I used to feel on Sunday when we had chicken for dinner. I was the small boy in the family. I saw the drumsticks cut off, the pieces of breast go, and finally, when it came my turn there was nothing left but the neck. To-day I have the neck, as far as the discussion of this problem is concerned.

But, while there is in the neck a good deal of bone, gristle, and a little muscle, there is in it the spinal cord. This applies to the university. The university contains plenty of gristle, but it also furnishes the spinal cord, for through it certainly pass a large number of people who get to the top and they control the body. That is what we are really driving at in this problem to-day—how may we reach the people so that they will be responsive to the great new information which has come to us.

Most of us were really raised in the patent medicine age. I got my early information in hygiene from the Sunday supplement and that kind of thing. I know about what the mental states of a large proportion of our population are in regard to health. We do a good deal to bring about this condition with our university courses. We put so much of the past and of the antique before our students that they often do not have time for up-to-date matters—matters of real importance. Perhaps this has a certain advantage. There is certainly no great hurry in the college course of to-day. You can take all the time you like. Last summer, driving through one of the California valleys, I passed a man walking along a lonely road carrying a rather worn and dilapidated looking pack. I stopped my automobile and said, "Wouldn't you like to ride?" "No, thank'ee," he said, " I ain't in no hurry—I ain't going nowhere." So every once in a while I get this impression from some college course—they are carrying an old bundle and they are in no hurry because they are not going anywhere.

Take the poor boy or girl who has to go to one of our old-established universities. Most of the things they get are not concerned with such vital and modern things as public health. There is a good deal more talk about the War of the Roses than there is about spontaneous generation or chlorophyll or any of the other things which concern us a great deal. The ordinary student is peculiarly unfitted for grasping public-health problems. I think the university with which I am connected is one of the few which require a course in biology of all students. And yet how can you say any man is educated who doesn't know biology? If you have no understanding of life itself, are you educated for life? If we are going to go forward out of the patent medicine stage, if we are to get away from the large group which we have in every community of those who say there is no such thing as disease, and so on, we must get the scientific facts into the minds of the people. The world is reached by facts now more than by opinions, and the university is a testing place for new thoughts and new facts. Facts must guide our lives if we are to get anywhere.

I have this feeling. We have now, with the child-health programs carried on by various organizations, started to develop a clientele so that 20 years from now there will be something really going on in public health. At any rate, there will not be a few of us who know and a great gap between us and the rest. There will be a lot of grown-ups from those children who understand the facts. We are going to get the same results that this country got from the long, slow process of education on the damaging effects of alcohol. Now, one way or another we gather together in the universities a large percentage of the best minds—boys and girls. We need not be conceited about it, but there is a fair chance that we get more leaders for the future than we get anywhere else. If we can give them a worthwhile education, if we can give them an appreciation of facts versus opinions, then I think we are going to perform a very great function. But the trouble with much of our education is that it does not live.

We must visualize and dramatize public health if we are going to make it effective.

I look on the university as the place where we try to get the most brains of worthwhileness together. And we must begin more than we ever have before to bring those brains in immediate contact with the people outside. We must get professors who can make more outside of the university than they can inside as professors but who choose the academic life. We must conceive our education from an entirely new angle; think of it not in the terms of to-day, but with the idea that we are trying to get people ready for 20 years from to-day. We can not do that by teaching things that were already 40 years old in 1880. We have got to keep education up to date. There isn't anything in the world so up to date as medicine, public health, and biology.

My suggestion, therefore, is that we try to get all of our universities and colleges to study the problem just as we must now study and revamp the medical curricula. They must realize that a cultured man does not necessarily mean a man who is familiar with dead languages. Yet the entrance examinations for many colleges and universities usually demand this. I think a man can get just as satisfactory culture from scientific studies if this work is thoroughly given. We must by strategy get into the college and into the university curriculum more of the real things of life. We must give students a biological conception of life, and when we do that with a certain limited number we have accomplished much. I suggest that you start in on the university presidents. They are a susceptible lot. I am satisfied that if you can try as public-health workers interested in this problem to get your subject with its many fundamental branches into the college curriculum, and at the same time go on with your efforts in the primary schools, you will be able in 20 years from now to present achievements in public health in this country of which we now do not even dream.

PUBLIC HEALTH AND THE FUTURE COMMONWEALTH.

Dr. LEWELLYS F. BARKER, *Johns Hopkins University*.

Participants in this congress are deliberately and courageously turning their faces toward the future; they are attempting to attain a knowledge of coming things; and they are seeking the best means of making provision for approaching needs. The speakers have emphasized anticipation rather than retrospection. As the conference draws toward its close, all must feel that the concentrated beam of light that has been directed forward has given a view of possibilities and of probabilities that is encouraging and inciting to effort.

Science and art would make but sorry progress if their devotees failed to infer the future. Discoveries nowadays are but rarely made by accident. On the contrary, they depend upon prearranged plans, upon clear definition of problems, upon ideas that have their origin in brooding over facts that have been collected, analyzed, arranged, and compared, and upon reasoning out the consequences of such ideas and testing them for their validity. Thus, and thus only can conclusions be arrived at that justify confident forecasts.

Prophecy to-day is a wholly different thing from what it was before the advent of the scientific method. Applying this method the chemist foretells the discovery of unknown elements and knows beforehand the qualities they must possess; the physicist gains glimpses of energy manifestations long before the technical procedures for demonstrating them have been devised; and the biologist can, by induction, mentally construct genotypes and phonotypes that have never yet existed but are none the less definitely realizable. Obviously public-health workers, also, should, by utilizing the scientific method, participate in prediction, estimate future needs, and visualize methods of meeting those needs.

We live in a rapidly changing world. The future of public health will differ, doubtless, markedly from the past. Knowledge of the past is, of course, necessary for the understanding of the present and is a helpful guide for conjecturing what is before us. Public-health workers are not likely to be unduly influenced by the view of that great industrialist who, it is alleged, declared that "history is bunk." On the contrary, they believe that what is coming must evolve by a natural process out of what has gone before. As the conditions of this evolution are learned and as the causes that are operative are recognized, forecasts of its general trend will become increasingly reliable.

Many in attendance at this conference believe that they can discern certain settled directions of advance, certain inevitable lines along which public-health work in the future must move. They are of the opinion that within a comparatively short time public-health activities will far exceed those of to-day, both in intensity and range. They feel sure that in this country, at least, the environment will speedily be made more wholesome, that the mass of the people will be led up the scale of personal hygiene and efficiency, and that possibly also the germ plasm of Americans may be gradually improved. In a general way, then, the main tasks of public-health workers for the future can be foreseen and certain of the results obtainable can be confidently predicted.

Public-health work should have as its ideal the provision through collective action (1) of conditions that will insure the birth of children with those inherited potentialities of physical and mental growth that are suitable for each successive stage of national and international development, and (2) of conditions that will promote the growth, the longevity, the physical and mental efficiency, and the social serviceableness of those that are born.

Private practitioners of medicine are most useful in the diagnosis and treatment of disease in single persons and in the advising of individuals and families regarding disease prevention and health promotion, but it has long since been learned that they are wholly unequal to the performance of the tasks imposed by the ideal to which I have referred. The size and the ever-increasing variety of these tasks necessitate the organization and maintenance of public-health services (local, State, national, and international) for the carrying on of the work. Hitherto, such public-health services have occupied themselves chiefly with (*a*) the provision of a more wholesome physical environment ("sanitation") and (*b*) the education of the people in the principles and methods of wholesome living ("personal hygiene"). It is only relatively recently that the public-health services have entered the fields of diagnostic and curative medicine (left formerly entirely to private practice); but experience with public medical and nursing services for maternal and child welfare; for the health of school children; for the early recognition and prompt treatment of certain infectious diseases, especially tuberculosis, gonorrhea, and syphilis; for the diagnosis, treatment, and custodial care of the insane, the feeble-minded, and the delinquent classes; and for the adequate care of the health of the population of those rural districts in which private physicians and nurses are unavailable would indicate that public-health workers will from now on become even more active in diagnostic and curative domains.

Again, the growing conviction that the maintenance of physical and mental health of individuals is definitely related to the industrial, the social, and the economic conditions in which they find themselves would make it seem likely, too, that in the near future the public-health service will be compelled to play a rôle in the invention and application of contrivances that will insure for every person in the Commonwealth standards of living that are not incompatible with the preservation of health or the maintenance of an abounding vitality. The problems that here confront the public-health investigator are not easy of solution. A vast amount of research will be required before the principles can be discovered and before the social and political apparatus can be devised that will dissipate the difficulties.

The eugenic problem, perhaps the most difficult and perplexing of all, has, as yet, been scarcely touched by public-health workers. Sanitary science, bacteriology, epidemiology, personal hygiene, medicine and surgery, modern nursing, and social service are improving the environment, preventing disease or recognizing it early and arresting it, prolonging life and ameliorating the conditions of life of individuals; but what are they doing to the race? May they not be causing racial deterioration through survival of persons who transmit inferior germ plasm? As environmental improvement keeps alive the biologically "less fit," should we not see to it that arrangements be made for the encouragement of parenthood by the "more fit," for the discouragement of parenthood by the "less fit," and for the prohibition of parenthood by the "notoriously unfit?" Otherwise will not the inborn capacities of man undergo progressive decrease and contribute to racial extinction? If biologists are right about heredity, should we refuse to face the facts? Ought we not rather resolutely to face them, cooperating with nature as we gain knowledge of her laws? These are some of the queries that biologists, and especially eugenists, are propounding. For these interrogators, eugenics would seem to be even more important than euthenics or environmental improvement for consideration by public-health workers in the future Commonwealth.

If the facts that we now possess concerning environmental influences on the one hand and heredity on the other could be systematically applied by public-health workers there would result an enormous push upward both in the health of individuals and in germ-plasm betterment. And, of course, the main duty of public-health administrators at a given time is to apply systematically for the promotion of health the knowledge that then actually exists. Legal enactments have their place in public-health work and police power must be exercised for maintaining the order that is conducive to public health; but these measures are far less important than others that are available, particularly the extension of educational policies, the improvement of social customs, the promulgation of better ethical standards, and the encouragement of various forms of art by which ideals of physical and moral beauty are determined, for these ideals are of great importance in influencing men and women in mate selection.

The facts should be told to the people in a way that will be understood by them and by persons who can convince them. For the masses heredity and environment are still wrapped in mystery. Public-health workers should be intermediaries between the scientist and the common man. Matters hidden from him or misunderstood by him should be brought to light and carefully explained to him. Germ plasms, fertilization, gestation, infancy, growth, puberty, adolescence, maturity, sex mating, parenthood, economic security, intellectual and emotional satisfaction, senility, disease, and death are among the subjects that require elucidation. The teachings of science must be especially prepared if they are to tempt the appetite and provide nourishment for the common man.

An efficient public-health service would go far toward supplying the information and compelling the convictions that would protect our people from health fads and fancies and from quacks and charlatans. If the average man and woman knew the facts about rheumatism, they would not waste much money on liniments; if they were trained in health habits they would refuse to swallow sawdust to overcome constipation; and they would get along without yeast cakes if they knew the sources of vitamins. It is partly the ignorance and credulity of the layman, partly the apathy and negligence of the medical profession, and partly the cupidity of the exploiter that account for the prevalence of the healing cults, the "pathies," and the nostrum mongers. Their reputed successes, like many of those of the regular practitioner of medicine, depend partly upon suggestion, partly upon the self-limiting nature of many diseases. Their failures and the positive injuries for which they are responsible are but little advertised. The public should know the facts; then only those who are incurably gullible need longer be duped.

In planning their work in the future Commonwealth, public-health workers will require periodically to revise their euthenic and eugenic aims in the light of extending knowledge. At each revision the program should be considered from two points of view—the individual and the racial.

In discussing desirable euthenic goals, for example, at present it would be well to keep in mind that a mere increase of the longevity of a person would scarcely be worth while if to attain it his life was made almost intolerable to him. May there not be a lack of sense of measure in some of our present-day health crusades? If life were to be very rigorously regulated—censored, sterilized, antisepticized, dealcoholized, and asexualized; if we were to be made afraid of life itself in order to live joylessly a little while longer—would the end gained justify the means? Americans have been called the "people of action"; but is action always preceded by sufficient thought and investigation? Are we not sometimes guilty of an almost reckless experimentation in environmental change?

Again, in discussing desirable eugenic goals—and I may say that I am exceedingly skeptical of the possibility of any extensive practical eugenic program until knowledge has been further increased and diffused—it would be well to keep in mind the difficulty in arriving at decisions as to who are "fit," who are "fitter," and who are "fittest" to survive, even though we arrived at a general agreement that certain groups are "manifestly unfit" and should be denied the privilege of parenthood. Is it not desirable as yet, at any rate, to have many different races of man in the world and many varieties and degrees of inborn capacities in the individuals of a single race? Instead of attempting to breed people who are nearly alike, no matter how superior the type, might it not be wiser to encourage variation and to attempt to preserve as many worthy and pleasing varieties as possible, adapting the circumstances to them when necessary rather than forcing them into an unfavorable milieu? Think how far physics, chemistry, and mechanics would have to advance before machines could be devised that would take the place of the working men and women now engaged in various "inferior" occupations. As knowledge grows and as social life becomes ever more complex, we shall need a greater variety of special aptitudes than ever before. There will be more rather than fewer kinds of services necessary in our social life, and it will be the task of vocational education to discover the particular kind of specialization to which each individual is most suited and to arrange for his proper articulation in the social machinery.

What public health will need more than anything else, however, is a steady increase of knowledge and persistent betterment of technique through scientific research. The only way to cooperate with nature is to discover natural laws and bring our activities into conformity with those laws. Nature is inexorable in the infliction of penalties. Ignorance is, for her, not an extenuating circumstance. You may not know that it is dangerous to take whisky before breakfast, but if you take it long enough and strong enough your liver will become hardened. Many an arthritis has developed from tooth infection about which the patient knew nothing until the X-ray revealed it. Blissfully disregardful as one may be of the qualities of the chromosomes of his own germ cells and those of his spouse, his offspring will inherit certain traits that are inevitably and mathematically distributed. Public-health services must arrange then both for the increase of knowledge useful for its purposes and for the training of the personnel to apply that knowledge.

Universities, Government laboratories, research institutes, and schools of sanitation and hygiene will be more and more called upon for facts that will promote work in public health and for trained men and women to make use of the facts. It is certain, I think, that this conference will later on be found to have done much to increase the interest in public-health functions, to stimulate the investigation of public-health problems, and to enlarge materially the number of men and women desirous of engaging in public-health work.

RECAPITULATION.

Dr. David L. Edsall, *Dean, Medical School and School of Public Health, Harvard University.*

I think in being given the title, so to speak, of recapitulator I have had imposed upon me the discussion of all previous papers. With your permission, Mr. Chairman, since the Surgeon General has asked me to act as chairman of a committee on recommendations, I will to some degree make reference to the discussions of that committee, and in order to save the time of the conference will make some recommendations from the committee at the end of these remarks.

In the discussion of the question of the education of public-health workers to those of us who are interested in university matters the most important elements are, of course, in the first place, how to secure the right kind of student and, in the second place, how to educate him. I was very much impressed with what Doctor Jordan found in the replies of medical students to his letter. These replies emphasized strongly what we all knew; i. e., that a large proportion of medical students have no idea what a public-health career means. The essence of the difficulty lies, I think, in what Doctor Dodson said; that is, medical-school teachers generally take very little interest in public health. I suppose it is true in most lines of work that teachers are often more conservative as to any changes in their subject than anyone else. Teachers of medicine were mostly trained in medicine when the preventive aspects of medicine were of little importance. I do not believe that we shall get much change in the attitude of the medical student until we can change the attitude of the medical faculties. We need not simply so many more hours assigned to hygiene, but what Doctor Dodson mentioned—that every individual with important teaching to do shall feel that his work is quite as important in relation to the preventive as to the curative aspects.

I would take issue somewhat with my colleague, Doctor Whipple, in one thing he said this morning, that the atmosphere of the medical school is properly different than that of the school of public health. Being in a medical school, whereas he is not, I may fairly take issue in that and say that their atmosphere should not be different. The medical school should appreciate that individual medicine is at present simply the most important arm of public health but not the whole structure. There must be an atmosphere of public health throughout the medical school as well as of individual health. It can be done I am sure.

One thing of interest in this relation has occurred with us this year. We have quite a remarkable group of physiologists who have arranged an advanced elective course for medical students which is fitted in its major parts for the public-health students at the same time—a course of lectures and demonstrations and reading. Here is a group of at least six professors of physiology who will in future be necessarily interested in the public health as well as in the medical aspect of their subject. I think by such means we shall gradually get the interest of the medical faculty. I think we shall not find our students answering wisely questions such as Doctor Jordan asked until our medical faculties can answer them. But, go back to what President Wilbur said—I had the same thing in mind—one main fault lies in this: Medicine itself and public health have changed wholly as professions in the last few years but our methods of teaching have not changed in their objectives in proportionate degree. We really are appealing, I think, almost solely to the same group of men that we appealed to a generation ago, to men of the same interests, the same tendencies in life. When young men in college are preparing to choose their careers they do not know the opportunities in medicine or public health. The variety and kinds of qualifications and tastes needed were never so great as at the present time. And particularly I think this ignorance of the variety of opportunity is true of college teachers. A large proportion of the students have their decisions as to careers determined, or influenced at least, by advice that they secure from persons in the college faculty, who particularly appeal to them as persons who can advise wisely. I am quite sure from talking with a great many of them that the college professor and instructor who guides these men in the choice of their career usually does not himself know anything of these diverse possibilities that exist in medicine and in public health. I think we have to educate them. We shall perhaps make more rapid progress in educating the men in the general faculty of the universities, for they are more flexible than the medical faculty in that they admit that they know less about it.

We have gradually got into very close contact with our department of physics, which formerly was not at all closely related to medicine. Two men are conjoint members of the physics department and of the medical school organization, though primarily physicists. Several other members of the physics department have said to me they thought they could often wisely advise men now to go into medicine and public health to make fine use of training in pure physics and as a field of advance of physics as a pure science. Our university department of chemistry, which has a large group of important men in it, has grown much interested in medical problems. One of them in particular is deeply interested in the problems of industrial medicine.

I believe this must be a gradual growth, but it is in this way that we shall influence students as to what medicine and public health offer. In other words, we need to get into medicine and public health nowadays men who will go into the problem not only from the humane standpoint—as is made very obvious from the discussion here—but from their interest in government, in administration, in social and economic science, and in the fundamental pure sciences. I think that by concerted effort we can change the sources of supply and get a very superior supply gradually. I do not think a superior supply can be rapidly secured by any means.

With regard to other problems, such as the question of remuneration, security, tenure of office, and things of that kind, these can only be overcome by patient, systematic effort and public-health education, as is obvious to all.

There are two things as regards the course of education that have been mentioned that we should insist upon because of the experience that medicine has had which is so obvious and so unfortunate. Listening to all of the discussion yesterday and to-day, I believe that if we would teach all that we have heard advised it would require a course of 10 years. Obviously not all these things can be taught. Medicine has suffered seriously from having the course terribly crowded. The effect has been bad on the student, and he has particularly lost his individual initiative. This lack of initiative on the part of the student is due to the fact that we have taken all the initiative away from him by settling his program too much by too schematic a course.

In the medical school I am connected with we recently have felt it necessary to do a major surgical operation and cut out between 25 and 30 per cent of the work we have crowded in, in order to give the student more time as an individual thinker. We must avoid crowded conditions in teaching public health.

As to the other thing—and this is among the recommendations of the committee—we must keep close together the discussion of medical education and the discussion of the educational problems in which this conference is interested. That is to say, the committee makes a recommendation that there be efforts made to have public-health education included as a part of the usual midwinter conference in Chicago, with the deliberate purpose of bringing into contact public-health education and medical education, so that each may influence the other and both develop together. It would be unfortunate were a continued discussion of public-health education to develop separate from a discussion of medical education. The two must develop together.

One other thing to be emphasized in any such discussion is that we ought to avoid the danger which we ran into in medical education of being overregulated by interested organizations. Medicine had to clean its Augean stables and it did it by putting regulations around everyone, good and bad. Gradually it became evident to the persons regulating it that this was dangerous. It has been a constant burden on those making excellent efforts. Very radical changes permitting of real elasticity are, therefore, being made in the program outlined for the curriculum at the Conference on Medical Education. Each medical school will have opportunity to have more individualistic development. Don't let us standardize public-health education. Let us try to avoid regulating schools that are teaching public health so that they tend to become stereotyped. In different parts of the country certain different types of things will have to be taught; different types of men will have to be developed in different places. To cripple an infant development of this kind before it has had time to grow would be a mistake. We can avoid being obliged to destroy things subsequently if we don't have too much regulation of the training of public-health officers.

In the discussion that came up in regard to the practical training of public-health officers a number of valuable suggestions were made. There are some other details I would mention. We have arranged a program so that students may take certain carefully arranged courses, of short duration, in industrial medicine, in child hygiene, in tropical medicine, or in university health organization with the idea that these will give them a distinct general knowledge of practical methods in public health. Our university health organization is, for example, in the hands of Dr. Roger Lee, really a community health organization. It can be used as a very striking demonstration of the results that can be accomplished by public-health work where you can work out a more or less ideal plan. Such a thing can be done in many universities. This is not teaching students what they have to meet in the field, but it will teach them certain important methods they can apply in the field.

I am quite sure some of the contacts we have made in industry offer an extraordinary opportunity to see how to handle a small community and, as Doctor Geier says, it gives an opportunity to study the human element, which is of very great importance. These matters are specialized types of training, but some knowledge of them can be made of great general value in the course. The individual's practical experience in a larger way ought to be more prolonged and ought to come after he has had his general training.

This conference was called to discuss both education in public health and the future of sanitarians. I do not need to dwell upon the great variety of contacts that public health must make in order to have the greatest amount of influence. The next to the doctor, his ally, is the nurse. There are others, such as the welfare worker, the teacher, and the press which are well recognized. One of the most important aspects of public health which has been repeatedly mentioned here is the economic side. We must have much exact knowledge of the economics of health such as the economist would accept, knowledge on which he can base actual recommendations for a course of action. We need to make very continued and patient studies in cooperation with expert economists. Scientific economic studies are of the utmost importance in convincing legislators, large philanthropists, and persons of that kind as to the needs for money, not based upon ideals but upon actual practical facts. Economic facts relating to health must for the most part be brought out by future painstaking research. Most of the talk about the economic importance of health, while probably largely true, has been too loose and ill-defined to be convincing.

We need to get into contact with other professions. Dr. Haven Emerson's brother at the Institute of Technology in Cambridge tells me that he makes his students know the elements of health in relation to architecture. If the health factor in relation to the building of houses, hotels, factories, and the variety of other structures in which human beings spend their time were considered in building, a great deal could be accomplished for health through the architect alone.

The structural engineer and the mechanical engineer have very important relations to health, especially in the building of machines and factories. If men in those professions knew the effect on health of what they were building a great deal could be accomplished. If men who built certain types of machines or factories that I have repeatedly seen had known just one or two points in regard to health or had got hygienic advice before they built, they could have saved much. In one case I recall the engineer could have saved constant labor troubles and in another instance he could have saved some hundreds of thousands of dollars subsequently expended in protecting employees against a peculiar industrial disease hazard. In another case the machines used in one room were built with such disregard of the human factor that there resulted labor troubles and ill health that interfered with the whole progress of the work in an enormous factory. In the future this phase must be taken up in some degree in relation to the progress of public health.

The recommendations of the committee on recommendations are these:

That the Surgeon General be requested and empowered to appoint a committee including—

Dr. C. C. Bass, of New Orleans;
Dr. W. H. Howell, of Baltimore;
Dr. A. J. McLaughlin, U. S. Public Health Service;
Dr. E. O. Jordan, of Chicago;
Dr. M. J. Rosenau, of Boston;
Dr. R. L. Wilbur, of Palo Alto;
Dr. Ennion G. Williams, of Richmond;
Dr. C.-E. A. Winslow, of Yale;

the committee to enlarge itself to 15, and that this committee consider whatever questions it sees fit, and take whatever further action for future conferences may seem wise in order to continue the activities that this conference has started.

Motion seconded and carried.

Motion made that Dr. Edsall's name be added to that committee.

Motion seconded and carried.

The CHAIRMAN. Any further remarks? Any further recommendations? Or further business before the conference?

Dr. M. P. RAVENEL. I believe that everybody in this conference will agree with me that this conference marks an epoch in public-health history. I wish to make a motion that this conference, made up of representatives of universities and other organizations, thank the Surgeon General and those who had been associated with him in calling this conference and arranging for our comfort while here.

The CHAIRMAN. Motion unanimously carried.

The business of the section having been concluded, I will turn the rest of the meeting over to the Surgeon General.

Surgeon General CUMMING. I wish to express the thanks not only of the Public Health Service, but of all the public-health officials in the country, particularly to the presidents of the several great universities and to the deans of the medical schools who have not been hitherto directly connected with public health, for coming to this conference at a great personal sacrifice. I feel sure that we have planted a tree within the last two days which will bear much fruit.

APPENDIX.

MEMBERS OF THE CONFERENCE.

PRESIDENTS OF UNIVERSITIES.

Angell, James R., Ph. D., LL. D., president, Yale University.
Chandler, J. A. C., LL. D., president, College of William and Mary.
Durkee, J. Stanley, M. D., president, Howard University.
Farrand, Livingston, M. D., president, Cornell University.
Goodnow, Frank J., LL. D., president, Johns Hopkins University.
Rhees, Rush, LL. D., president, University of Rochester.
Trotter, Frank B., LL. D., president, University of West Virginia.
Wilbur, Ray Lyman, M. D., LL. D., president, Stanford University.
Woods, Albert F., D. Agr., president, University of Maryland.

DEANS AND DIRECTORS OF SCHOOLS OF PUBLIC HEALTH, HYGIENE, AND MEDICINE.

Abbott, Alexander C., M. D., director, school of hygiene and public health, University of Pennsylvania.
Allison, Nathaniel, M. D., dean, Washington University school of medicine, St. Louis, Mo.
Bardeen, Charles Russell, M. D., dean, school of medicine, University of Wisconsin.
Cabot, Hugh, M. D., dean, University of Michigan Medical School.
Dodson, John Milton, M. D., dean of medical courses, University of Chicago and Rush Medical College.
Doughty, W. H., jr., M. D., dean, medical department, University of Georgia.
Edsall, David Linn, M. D., dean of the medical school and school of public health, Harvard University.
Gile, John M., M. D., dean, Dartmouth Medical School.
Halsey, John J., secretary, school of medicine, Tulane University of Louisiana, New Orleans, La.
Hart, C. D., associate professor public health, College of William and Mary, Williamsburg, Va.
Keiller, William, acting dean, medical branch, University of Texas, Galveston, Tex.
Kober, George M., M. D., dean, Georgetown University medical school.
Lyon, E. P., M. D., dean, medical school, University of Minnesota.
MacCracken, W. H., M. D., dean, Detroit College of Medicine and Surgery.
McElroy, James B., M. D., president of faculty, college of medicine, University of Tennessee.
Miller, E. C. L., M. D., dean, Medical College of Virginia.
Page, Henry, M. D., dean, college of medicine, University of Cincinnati.
Pearson, W. A., M. D., dean, Hahnemann Medical College.
Robinson, G. Canby, M. D., dean and professor of medicine, Vanderbilt University Medical School.
Rowland, J. M. H., M. D., dean, medical department, University of Maryland.
Schmitt, L. S., M. D., acting dean, University of California Medical School.
Schulte, H. von W., M. D., dean, Creighton University College of Medicine.
Tracy, Martha, M. D., Dr. P. H., dean, Woman's Medical College of Pennsylvania.

Welch, William H., M. D., director, school of hygiene and public health, Johns Hopkins University.

Whipple, George H., M. D., dean of the school of medicine and dentistry, University of Rochester.

Wilson, Robert, jr., M. D., dean, Medical College of the State of South Carolina.

Woody, McIver, M. D., dean, Baylor University College of Medicine.

PROFESSORS OF PUBLIC-HEALTH SUBJECTS AND OTHER EDUCATORS.

Baketel, H. Sheridan, M. D., professor of preventive medicine and hygiene, Long Island College Hospital.

Barker, Lewellys F., M. D., medical department, Johns Hopkins Hospital.

Belt, Richard B., M. D., Baltimore, Md.

Davis, Donald W., professor of biology, College of William and Mary.

Emerson, Haven, M. D., Cornell School of Hygiene, New York.

Freeman, Allen W., M. D., resident lecturer, public-health administration, school of hygiene and public health, Johns Hopkins University.

Garcia, Maj. Leon C., United States Army, professor of military science and tactics, St. Louis University School of Medicine.

Goodrich, Annie, D. Sc., teachers college, Columbia University.

Hayhurst, E. R., M. D., professor of public health, Ohio State University.

Haythorn, Samuel R., M. D., director of hygiene, University of Pittsburgh.

Howell, W. H., M. D., assistant director, school of hygiene and public health, Johns Hopkins University.

Jackson, Algernon T., M. D., professor of public health and hygiene, Howard University School of Medicine.

Jordan, Edwin O., Ph. D., professor of bacteriology, University of Chicago.

Leigh, Robert D., lecturer, Columbia University, New York City.

Mahon, T. McC., instructor in hygiene, University of Pittsburgh.

Meredith, Florence, M. D., professor of hygiene, Woman's Medical College of Pennsylvania, Philadelphia, Pa.

Mitchell, O. W. H., M. D., professor of bacteriology and hygiene, Syracuse University.

McCollum, E. V., M. D., professor of biochemistry, school of hygiene and public health, Johns Hopkins University.

Perkins, Roger G., M. D., professor of hygiene, school of medicine, Western Reserve University.

Park, William H., M. D., professor of bacteriology and hygiene, University and Bellevue Hospital Medical College, New York City.

Ravenel, Mazyck P., professor of bacteriology and preventive medicine, school of medicine, University of Missouri.

Rosenau, Milton J., professor of preventive medicine and hygiene, Harvard Medical School.

Rosenberger, Randle C., M. D., professor of hygiene and bacteriology, Jefferson Medical College, Philadelphia, Pa.

Rushmore, Stephen, M. D., associate professor of gynecology, Tufts College Medical School, Boston ,Mass.

Sears, Dr. Heber J., professor of hygiene and preventive medicine, University of Utah, Salt Lake City, Utah.

Seashore, Carl E., Ph. D., chairman, division of anthropology and psychology, National Research Council, and dean of the graduate college, University of Iowa.

Smith, Richard M., M. D., instructor in pediatrics, Harvard University Medical School, Cambridge, Mass.

Sundwall, John, Ph. D., M. D., director, division of hygiene and public health, University of Michigan, Ann Arbor, Mich.

Torrey, Harry Beal, Ph. D., director of medical research, University of Oregon, Portland, Oreg.

Turner, C. E., assistant professor of biology and public health, Massachusetts Institute of Technology, Boston, Mass.

Walker, Elton D., professor of hydraulic and sanitary engineering, Pennsylvania State College, State College, Pa.

Whitmore, Eugene R., M. D., Dr. P. H., professor of bacteriology and preventive medicine, George Washington University, Washington D. C.

Whipple, George C., S. B., professor of sanitary engineering, Harvard University, Cambridge, Mass.

Williams, Jesse F., M. D., associate professor of physical education, teachers college, Columbia University, New York City.

Winslow, C.-E. A., Dr. P. H., professor of public health, Yale University School of Medicine, New Haven, Conn.

Zinsser, Hans, M. D., professor of bacteriology, Medical School of Columbia University, New York City.

STATE AND CITY HEALTH OFFICERS.

Black, John T., M. D., commissioner of health, Hartford, Conn.

Biggs, Hermann M., M. D., commissioner of health, State of New York, Albany, N. Y.

Crumbine, S. J., M. D., secretary and executive officer, Kansas State Board of Health, Topeka.

Dalton, Charles F., M. D., secretary, Vermont State Board of Health, Burlington.

Durrett, J. J., M. D., superintendent of health, Memphis, Tenn.

Chesley, A. J., M. D., executive health officer, Minnesota State Board of Health, St. Paul.

Fronczak, Francis E., M. D., health commissioner, Buffalo, N. Y.

Goldsbury, Paul W., M. D., secretary, Rural Health and Medical Service, Deerfield, Mass.

Kelley, Eugene R., M. D., State commissioner of public health, Boston, Mass.

Levy, James A., M. D., State health officer, Columbia, S. C.

McCormack, A. T., M. D., State health officer, Louisville, Ky.

Nicoll, Matthias, jr., M. D., deputy commissioner of health, Albany, N. Y.

Olin, Richard M., M. D., commissioner of health, Lansing, Mich.

Snively, Harry H., M. D., director of health, Columbus, Ohio.

Vaughan, Henry F., M. D., commissioner of health, Detroit, Mich.

Wadsworth, Augustus, M. D., division of laboratories, State Department of Health, Albany, N. Y.

Welch, S. W., M. D., State health commissioner, Alabama State Department of Health.

Williams, Ennion G., M. D., State health commissioner, Richmond, Va.

REPRESENTATIVES OF SEMIPUBLIC AND PRIVATE HEALTH ORGANIZATIONS.

Armstrong, D. B., M. D., executive officer, National Health Council.

Brown, Walter H., M. D., director, child health demonstration, National Child Health Council, Mansfield, Ohio.

Dublin, Louis I., Ph. D., statistician, Metropolitan Life Insurance Co.

Ferrell, John A., M. D., Dr. P. H., director for the United States, International Health Board of Rockefeller Foundation.

Frankel, Lee K., Ph. D., third vice president, Metropolitan Life Insurance Co.

Geier, Otto P., M. D., director, employees' service department, Cincinnati Milling Machine Co., Cincinnati, Ohio.

Green, Frederick R., M. D., secretary, council of health and public instruction, American Medical Association.

Hatfield, Charles J., M. D., managing director, National Tuberculosis Association.

Kellogg, Vernon, Ph. D., permanent secretary, National Research Council.

Snow, William F., M. D., general director, American Social Hygiene Association; lecturer, school of hygiene and public health, Johns Hopkins University.

Calver, Homer N., director, health service, American Red Cross, national headquarters.

Vaughan, Victor C., M. D., chairman, division of medical sciences, National Research Council.

Vincent, George E., Ph. D., LL. D., president, Rockefeller Foundation.

Work, Hubert, M. D., president, American Medical Association, Postmaster General of the United States.

Yerkes, Robert M., M. D., chairman, research information service, National Research Council.

REPRESENTATIVES OF VARIOUS FEDERAL AGENCIES.

Butler, Charles S. J., M. D., commanding officer, Naval Medical School.

Davis, William H., M. D., chief statistician, vital statistics, Bureau of the Census.

Bell, W. B., division of economic investigations, Bureau of Biological Survey.

Howard, L. O., M. D., Ph. D., Chief, Bureau of Entomology, Department of Agriculture.

Ireland, M. W., major general, Surgeon General United States Army.

Jones, R. F., M. D., lieutenant commander, in charge division of preventive medicine, Bureau of Medicine and Surgery, Navy Department.

Parker, Valeria H., M. D., executive secretary, Interdepartmental Social Hygiene Board.

Rude, Anna E., M. D., director, division of hygiene, Children's Bureau.

Siler, J. F., M. D., lieutenant colonel, Medical Corps, United States Army.

Small, Willard S., Ph. D., specialist in school hygiene, Bureau of Education.

Stitt, E. R., M. D., rear admiral, Surgeon General United States Navy.

White, William A., M. D., superintendent, St. Elizabeths Hospital.

White, William Charles, M. D., chairman, consultants on hospitals under Secretary of Treasury; chairman, medical research committee, National Tuberculosis Association.

REPRESENTATIVES OF THE UNITED STATES PUBLIC HEALTH SERVICE.

Carter, H. R., M. D., Assistant Surgeon General at large.

Clark, Taliaferro, M. D., surgeon in charge of child hygiene.

Cumming, Hugh S., M. D., Surgeon General.

Draper, W. F., surgeon, rural sanitation, United States Public Health Service, Richmond, Va.

Frost, W. H., M. D., surgeon, professor of epidemiology, Johns Hopkins University School of Medicine.

Goldberger, Joseph, M. D., surgeon in charge of pellagra investigations, Division of Scientific Research.

Kerr, J. W., M. D., Assistant Surgeon General, in charge of Division of Personnel and Accounts.

Lavinder, C. H., M. D., Assistant Surgeon General, in charge of Division of Hospitals and Relief.

Lumsden, L. L., M. D., surgeon in charge of rural sanitation studies.

McCoy, G. W., M. D., surgeon, Director Hygienic Laboratory.

McLaughlin, Allan J., M. D., Assistant Surgeon General, in charge of Division of Domestic Quarantine.

Pierce, C. C., M. D., Assistant Surgeon General, in charge of Division of Venereal Diseases.

Schereschewsky, J. T., M. D., Assistant Surgeon General, in charge of Division of Scientific Research.

Stiles, Charles W., M. D., professor and Chief of the Division of Zoology, Hygienic Laboratory.

Stimson, A. M., M. D., surgeon, Assistant Director Hygienic Laboratory.

Sydenstricker, Edgar, statistician, in charge of statistical research, Division of Scientific Research.

Thompson, L. R., M. D., surgeon, in charge of section of industrial hygiene, Division of Scientific Research.

Young, G. B., M. D., senior surgeon, Marine Hospital No. 21.

○

TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 127
SEPTEMBER, 1922

THE EPIDEMIOLOGY OF BOTULISM

By

J. C. GEIGER, Epidemiologist, U. S. Public Health Service
E. C. DICKSON, Stanford University Medical School, and
K. F. MEYER, George Williams Hooper Foundation for Medical Research, University of California, and California State Board of Health in San Francisco

Prepared by Direction of
THE SURGEON GENERAL

WASHINGTON
GOVERNMENT PRINTING OFFICE
1922

TABLE OF CONTENTS.

Page.

I. Introduction 1
II. General considerations 4
III. Human botulism in California 8
    Age and sex distribution 20
    Intoxication rate 21
    Case mortality rate 21
    Seasonal distribution 22
    Foodstuffs responsible for the outbreaks 23
    Physical appearance of the incriminated food 27
    Geographical distribution 28
IV. Human botulism in the State of Washington 30
    Botulism survey in the Yakima Valley 31
V. Human botulism in the United States and Canada, exclusive of the States of California and Washington 39
    Age and sex distribution 50
    Intoxication rate 50
    Case mortality rate 50
    Seasonal distribution 51
    Foodstuffs responsible for the outbreaks 51
    Physical appearance of the incriminated food 54
    Geographical distribution 55
VI. Botulism in domestic animals 58
    Botulism in barnyard fowls 58
        Number of outbreaks and mortality rate 59
        Foodstuffs responsible 64
        Bacteriological and toxicological diagnosis 66
        Is *B. botulinus*, type B, responsible for botulism in poultry? 68
        Geographical distribution 68
    Botulism in horses 69
    Botulism in cattle 77
    Botulism in hogs 79
    Botulism in dogs, cats, and goats 81
VII. Features of botulism 83
    Symptomatology and course 83
    Mortality 88
    Pathology 88
    Serum therapy 90
    Bacteriological diagnosis 92
        Determination of the presence of *B. botulinus* in the remnants of the causative food 95
        Isolation of *B. botulinus* from the suspected food 96
        Isolation of *B. botulinus* from the stools of clinical cases 96
        Isolation of *B. botulinus* at necropsies 97
        The types of *B. botulinus* responsible for botulism in the United States 98

Page.
VIII. General discussion 99
B. botulinus infection versus intoxication due to preformed toxins 99
The economic importance of spoilage due to *B. botulinus* in home and commercially canned food 101
A comparison of the food products responsible for botulism in the United States and in Germany 107
IX. Conclusions 110
X. Summary 117
Bibliography 118

ILLUSTRATIONS.

Figure 1. Food poisoning in the United States, by years 5
2. Seasonal distribution of botulism in California 22
3. Foods responsible for botulinus poisoning in California 23
4. Botulism survey, California 29
5. Foods responsible for botulinus poisoning in Washington, particularly Yakima Valley 36
6. Botulism survey, Yakima County 37
7. Foods responsible for botulinus poisoning in the United States and Canada, exclusive of California and Washington 51
8. Botulism survey, United States 56
9. Botulism in barnyard fowls 64
10. Seasonal distribution of 76 cases of equine forage poisoning 77
11. Onset of symptoms of botulism in 213 cases 83
12. One hundred and seventy-three deaths occurred on the following days after the consumption of the causative meal 87
13. Mortality compared with time of onset of symptoms 89
14. Showing what followed administration of homologus antitoxin in 6 outbreaks 91
15. Total number of home-canned food products responsible for human and chicken outbreaks 101
16. Food and food products responsible for botulinus poisoning in United States and Canada 104
17. Food and food products responsible for botulinus poisoning in Germany 108

THE EPIDEMIOLOGY OF BOTULISM.[1]

PART I.

INTRODUCTION.

Impressed by the grave responsibility thrust upon the canning industry of this country incidental to the tragic botulism outbreaks, which followed the consumption of factory-preserved ripe olives, the National Canners Association, the Canners League of California, and the California Olive Association proposed in December, 1919, a detailed investigation in order to determine the danger from botulism, how it arises, and how it can best be avoided and overcome. Through the instrumentality of the above-named associations, funds were provided to support research work on certain definite phases of botulism in the United States, and a commission was formed in California to supervise the work on the Pacific coast. The commission was composed of the following members: J. C. Geiger, epidemiologist of the United States Public Health Service, E. C. Dickson, associate professor of medicine in the Stanford University Medical School, and K. F. Meyer, professor of research medicine and acting director of the George Williams Hooper Foundation for Medical Research, representing the University of California and, as consulting bacteriologist, the California State Board of Health.

It was decided that the investigation should be conducted in three directions: First, a careful statistical analysis of the anatomical and bacteriological data, which were already available or which could be collected from previous outbreaks of human and animal botulism; second, a clinical study of typical and atypical cases with special emphasis on the value of the specific serum treatment; and, third, an extensive experimental study dealing with the distribution and sources of *B. botulinus*, including particularly an investigation of the factors predisposing to the production of toxin in certain types of food. The original plans to confine the study to botulism in the State of California were subsequently broadened and this report includes a study of all the outbreaks in the United States concerning which records were available.

---

[1] This investigation was aided by a grant from the National Canners Association, the Canners League of California, and the California Olive Association.

The epidemiologic field studies were undertaken by Dr. J. C. Geiger, who personally investigated every important outbreak of botulism occurring in the States of California, Oregon, Washington, Arizona, and Colorado. Health officers, physicians, and officials of the various food and drug departments were interviewed relative to food poisoning cases resembling botulism. Through the cordial cooperation of various agencies, prominent among which were the western district of the Federal Bureau of Chemistry, various local and State boards of health and many individual physicians and veterinarians, the occurrence of outbreaks was usually early reported to the members of the commission. It should also be mentioned that attention to the possible prevalence of food poisoning was sometimes drawn by casual press reports. It is most unfortunate that food poisoning, food infections, and botulism are reportable diseases only in the States of California, Oregon, New York, and Kansas. Many public-health authorities possess no information relative to the frequency of food or "ptomaine poisoning" and an accidentally recognized case of botulism is either dismissed as unimportant or is not studied in a manner which enables an epidemiologist to reconstruct the important phases of the outbreak. Not infrequently improperly qualified and inexperienced persons are entrusted with the investigation of food-poisoning outbreaks. Evidence of the greatest value is overlooked and the incriminated food is referred to laboratory workers who are not qualified to pass judgment on a food suspected of causing poisoning. It is quite evident that the data analyzed were obtained from a diversity of sources and therefore cannot be of desired unformity. In several instances the facts available are so unsatisfactory that definite conclusions are necessarily impossible.

EPIDEMIOLOGY OF BOTULISM.

No.............
Series:.............. County:...................... Town:....................

CLINICAL DATA.

Name:...................................... Age:.......... Sex:............
Residence:............ Occupation: .... Address:........................
Date of onset:............... Physician and address:..............................
.... Diagnosis:.................... Date seen:..........
Present status:...................... Recovery:........... Died:.............
Symptoms:...
Treatment of fatal and recovered cases:.......................................
.... Serum treatment, if any:........
Autopsy:.............. Date:............. If coroner's case, state:...........
By whom:..
Anatomical findings:..
Laboratory examinations of clinical and autopsy material:.........................

EPIDEMIOLOGY.

Causative meal:.. Date:..............
Home or factory canned:.............. How:.......... Date:..............
Approximate amount consumed:..
Causative food factors:.............. Taste:............. Description:..........
Laboratory examination:..

[Back of card.]

ANIMAL INTOXICATIONS.

Animal on premises:........ Number of horses affected:......... Feed:..........
Number of cattle affected:.......... Feed:..........
Number of hogs affected:........... Feed:..........
Number of chickens affected:...... Feed:..........
Number of turkeys affected:........ Feed:..........
Date of illness:............. Symptons:..
Number of deaths:...
Autopsy:............... By whom:....................... Date:..............
Anatomical findings:..
Laboratory examination:...

REMARKS.

....

....

For the collection of the data by the commission a filing card (5 by 8 inches) was prepared, covering the significant points regarding the patients and the causative meal. Space was provided on these cards for a study of botulism in animals, inasmuch as it was sometimes intimately associated with human cases. The details of the card are illustrated above.

Pathologic and bacteriologic studies of food and soil samples were conducted in the laboratories of the University of California and Stanford University. The bacteriologic researches were carried out by Miss Bertha Dubovsky and Miss Florence Field. Studies of the pathologic histology of the material were undertaken by Dr. W. Ophüls and Dr. G. Y. Rusk.

ACKNOWLEDGMENTS.

It is not practicable to make personal acknowledgment to the many health officers, physicians, veterinarians, etc., to whom the commission is under great obligation for interest and cooperation. Patients were approached only through their local physicians and health officers and in no case did the commission find anything but the most ready cooperation on the part of the medical advisers and health authorities, many of whom actively associated themselves in the work at a considerable expenditure of time and effort.

PART II.

GENERAL CONSIDERATIONS.

How frequently botulism occurs in the United States is not definitely known and the statistics on food poisoning fail to suggest even approximately the incidence of this intoxication. Since cases of food poisoning, "ptomaine poisoning," and similar maladies are not legally reportable, public-health authorities possess no information relative to their occurrence. Jordan (1) has shown that inaccurate conclusions can be drawn as to the prevalence of certain kinds of food poisoning by the casual press reports which are available. He collected through a press clipping bureau and other sources during the period October, 1913–October, 1915, a total of 375 group and family outbreaks, which involved 5,238 persons. It is not unlikely that the number ascertained falls far short of the actual status. Jordan (1) reached the conclusion that "probably several thousand outbreaks of food poisoning in families and larger groups, affecting at least 15,000 to 20,000 persons, occur in the United States in the course of a year."

The number of fatal cases of food poisoning varies greatly in different outbreaks and inasmuch as no definite records are available, one is again forced to make use of inconclusive evidence. According to a compilation made by the United States Public Health Service from the mortality statistics in the United States, 5,537 deaths are attributed to poisoning by food from 1910 to 1918, inclusive. It is naturally impossible to verify the diagnoses on which these figures are based, but it is not unlikely that a number of deaths have been and are at present incorrectly considered the result of an attack of food poisoning. In subsequent chapters it will be shown that the case mortality rate in European food poisoning outbreaks is 1.5 per cent. Applying this rate to the American data estimated by Jordan it is noted that the actual mortality from poisoning in the course of one year would approximate 300 deaths. From Chart I, it is, however, evident that the actual mortality from food poisoning according to the above-mentioned statistics has increased from a total of 157 cases in 1910, to a total of 842 cases in 1918. The estimates of Jordan must therefore be looked upon as conservative.

There is little doubt that intestinal or other disorders due to particular articles of food occur more frequently than is generally believed to be the case. As a cause of death food poisoning and food infections are less important than, for example, typhoid fever. In this connection, it is recalled that the actual number of cases of typhoid fever in the United States in the year 1914 was estimated at 198,000 and the deaths were probably 19,800. (Dublin Am. Jour. Public Health, 1915, 5, p. 20.) Judging from the usual newspaper publicity given to food poisoning outbreaks one would conclude that not typhoid fever but food poisoning is a common disease. The tendency to incriminate preserved food as the cause of disease or death is certainly not the outcome of scientific inquiries but rather the result of popular prejudice and tradition.

In Table 1, the figures representing the mortality attributed to food poisoning in several States are compared with those proven to be due to botulism. The latter figures regarding botulism are compiled from the data collected by the commission and are in all probability fairly complete for the period 1915–1921. This statement is particularly true for the deaths which occurred in groups and where there was more than one fatality in a family. These group fatalities, on account of their dramatic character, attract considerable attention, stimulate medico-legal investigations, and lead to publicity in the daily press or in medical literature. Moreover, during the stated period a number of agencies have been interested in botulism and it can be assumed that every group of food intoxications has been carefully scrutinized for botulism cases. On the other hand, it should be remembered that botulism may be mistaken for methyl-alcohol poisoning, epidemic encephalitis, cerebrospinal syphilis, etc. Furthermore, it is not unlikely that quite a number of single fatal cases of true botulism have been diagnosed and reported incorrectly or have been placed, for the sake of convenience, in the all-embracing class of "ptomaine poisoning." If one admits that the mortality statistics on botulism are incorrect or incomplete it is quite obvious that in all probability a number of nonfatal cases have escaped recognition. The records of clinical cases of botulism which occurred in groups and families indicate that the consumption of the poisonous food may frequently produce mild or indefinite symptoms. These incidences of intoxication may be overlooked.

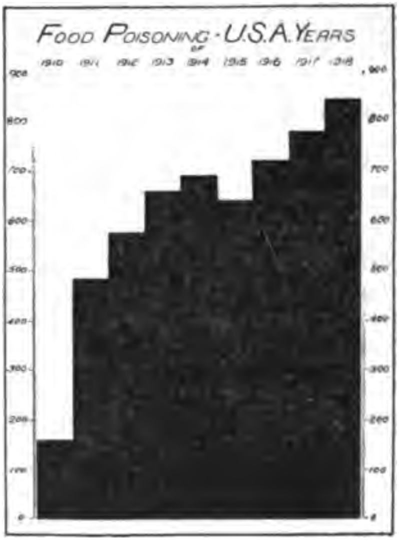


Fig. 1.

Definite information relative to the extent of fatal or nonfatal botulism in the United States can only be expected when all suspected cases are carefully investigated and the clinical diagnosis confirmed by toxicological or bacteriological methods.

TABLE 1.—*Mortality food poisoning in 10 States of North America.*

	1910–1917		Total.	Death from botulism, 1910–July 31, 1921.[1]
	Cities.	Rural districts.		
California	179	202	381	76 (1910–1918[1]—59 —15 per cent).
Colorado	25	71	96	13
Indiana	80	171	251	6
Massachusetts	130	50	180	4
Michigan	107	166	273	10
Montana	17	29	46	5
New York	269	177	446	16
Ohio	189	215	404	7
Pennsylvania	161	276	437	6
Washington	64	84	148	16 (1910–1918[1]—8 —5.4 per cent).

[1] Note discrepancy in periods.

Considering the figures presented in Table 1, apropos of the above discussion, it is evident that outbreaks of botulism are not infrequent in the United States. In California and Washington, two States in which the commission has made very careful inquiries relative to the incidence of the intoxication, only 15 and 10.8 per cent respectively of the total mortality due to food poisoning can with certainty be attributed to botulism. In other States this percentage is even smaller, for example in New York, probably less than 4 per cent of all deaths due to food poisoning are presumably caused by this intoxication. As a cause of death, however, this disease is by no means as important as the prominence given recently by the daily press and by numerous publications in the medical journals would imply. Although the number of actual cases of botulism is thus far comparatively small, it should, however, be emphasized that in recent years a striking increase in this disease has taken place in various localities. Foodstuffs which were considered to be unsuitable for the development of *B. botulinus* have recently been found to be the cause of this type of poisoning, and laboratory studies have demonstrated that *B. botulinus* is more widely disseminated in nature than has generally been suspected. All these facts create a feeling of uneasiness.

The question whether botulism is an old or new disease of the United States can not be answered conclusively. A review of the available records reveals the fact that the first clinically characteristic cases were described in the period from 1899 to 1902. The existence of the disease was later definitely established by the publications of Sheppard (2), of Peck (3), and Wilbur and Ophuls (4), which appeared in the period from 1907 to 1914. From the subsequent records in the medical literature one gains the impression that botulism in the United States is an acquisition of the last 5–10 years. It is the purpose of this epidemiological study to determine the factors responsible for the occurrence and furthermore to establish, if possible, the forces operative for its apparent alarming increase. It is obvious that the few questions just raised can only be answered after a discussion of botulism from a clinical, pathological, bacteriological, and toxicological viewpoint. Such a discussion must also consider the causative organism and the various contributory factors inducing the formation in certain foodstuffs of highly potent toxin. Although most of the information relative to the last-named factor can only be obtained through an extensive experimental study, an attempt is herewith made to draw from the reports of the various botulism outbreaks in the United States as much evidence as possible bearing on this point. Inasmuch as the commission concentrated its work on the States of California and Washington, the data pertaining to these two States are primarily chosen for analysis, although supplementary details are derived from the reports dealing with the outbreaks in other States of the Union. In following this plan, the commission does not intend to imply that botulism is primarily a problem of California or of the Pacific Coast States. The organization in the State of California enabled the commission to investigate details most carefully and trace sources of information, which were inaccessible in other States. It is not unlikely that many of the essential findings determined for the Pacific coast could be duplicated by the activities of a similar commission in other localities.

PART III.

HUMAN BOTULISM IN CALIFORNIA.

A. Single Cases or Those Occurring in Groups and Families, Proven by Bacteriological and Toxicological Tests.

PLANT PRODUCTS.

(a) STRING BEANS.

REPORT 1.—*String beans, purchased in open market and home canned.*

In January, 1916, at San Jose, Calif., an adult woman noticed an unpleasant odor when she opened a jar of beans. She tasted one pod and decided it was not spoiled, but when she heated the beans an offensive odor was given off. She then tasted another pod and decided that the beans were spoiled and discarded them.

Typical symptoms of botulism appeared within 24 hours and the patient died on the fifth day after tasting the beans. Necropsy showed marked congestion of the vessels of the meninges of the brain and cord and areas of broncho-pneumonia and hemorrhages in the lungs. On microscopic examination cellular thrombi were found in the blood vessels of various organs.

Laboratory tests showed a leukocytosis of 17.600 on the last day of life. The urine was normal.

Chickens which ate the discarded beans developed typical fowl botulism and died. *B. botulinus*, type A, was recovered from the crops.

Reported by Dickson. Monograph of Rockefeller Institute, No. 8, 1918, pp. 25–27.

REPORT 2.—*String beans, home grown and home canned.*

In January, 1917, at Escondido, Calif., eight persons ate salad prepared from uncooked canned string beans with mayonnaise. None noticed any unusual odor or taste when at table but one waitress, who had helped prepare the salad, stated that the contents of one of the two cans used did not taste quite right. Seven adults (five women and two men) developed typical symptoms of botulism and four died. Of the fatal cases, one developed symptoms within 24 hours, one on the second day, one on the fourth and one on the fifth day, while of those who recovered the onset of symptoms in two was on the second day and in one on the fourth day. Death occurred on the third, seventh, eighth, and twenty-sixth days.

Blood counts taken on the eleventh day in two cases which recovered and in one which died on the twenty-sixth day showed R. B. C. 5,300,000, 5,400,000, and 5,200,000, respectively, and W. B. C. 7,000, 13,000, and 12,500, respectively. The differential count was not unusual. The blood pressure in one case which recovered was 136/90 (Mercer).

Necropsy was performed in two cases. Neither showed broncho-pneumonia, but the vessels of one victim contained cellular thrombi.

B. botulinus was recovered from a can of beans of the same pack which remained in the cellar.

Reported by Dickson. Monograph of Rockefeller Institute, No. 8, 1918, pp. 30–37.

(*b*) SPINACH.

REPORT 3—*Spinach, commercially canned.*

In October, 1920, at Oakland, Calif., a number of persons in a hospital consumed spinach which had been baked. Two No. 10 cans (about 78 ounces) had been opened and the contents placed in a pan and baked for about twenty minutes. When opened the spinach appeared good, but when heated an unpleasant odor was given off. A head nurse, who noted the odor, tasted a portion of the baked spinach from the top of the mass and told the chef to discard it as it was spoiled. The chef picked out what he believed to be spoiled, added the contents of another can, and served the new mixture. Those of the victims who were most severely poisoned ate several helpings of the spinach with vinegar, but at least one noted an unusual taste which she mentioned as tasting like cheese.

Six persons (three women and three men) developed typical symptoms of botulism, and two women and one man died. In four cases the onset of symptoms occurred between 24 and 36 hours after the ingestion of the poison, although one of the four patients was less severely poisoned and was not confined to her bed until the fifth day. She was the only one of the more serious cases to survive. The two remaining patients first showed symptoms on the third and fourth days after the meal, and were very mild cases. They both recovered. The nurse who tasted the cooked spinach from the top of the loaf did not become ill. Examinations of the blood of two patients who recovered showed R. B. C. 5,200,000 and 5,500,000, respectively, and W. B. C. 12,500 and 7,000, respectively. The differential counts showed nothing unusual.

Necropsy was performed in two cases. In both the bodies had been embalmed before the brains were removed and the degree of engorgement could not be determined. In one the blood vessels of the brain contained cellular thrombi.

One of the patients who died was given intravenous injections of a mixture of types A and B antitoxin, a few hours before she died, without any indication of even temporary benefit. Two patients who recovered were also given both types of antitoxin on the fifth and sixth days after ingestion of the poison, but there is no definite evidence that the course of the intoxication was influenced by it.

B. botulinus, type A, was isolated from the stools of two survivors on the sixth, seventh, and on the twelfth days, respectively, after ingestion of the poison. There was no material available for direct bacteriologic investigation.

Investigated by the commission. Reported by Geiger. U. S. Public Health Reports, 1920, vol. 35, p. 2858, and 1921, vol. 36, p. 1313.

REPORT 4.—*Spinach, commercially canned.*

In June, 1921, at San Diego, Calif., three persons ate spinach which had been boiled for 20 minutes in fresh water after removal from the can. On the following day one woman consumed the remaining portion of spinach after "heating it." There was nothing reported as unusual in the appearance, taste, or odor of the spinach even while being boiled.

Thirty-six hours after eating the "heated" spinach, the last woman developed typical symptoms of botulism, but those who ate the boiled spinach did not become ill. At the onset of symptoms, the patient took large doses of salts. She recovered.

The spinach was grown on farms fertilized with sewage in the same district where spinach which has been responsible for other outbreaks of botulism was grown. It was packed in Los Angeles in 1919, and had been in the grocer's stock for 18 months.

Washings from the can killed a guinea pig on the tenth day, and *B. botulinus*, type A, was isolated from the stool of the patient on the sixth day after she had eaten the spinach.

Investigated by the commission.

(c) APRICOTS.

REPORT 5.—*Apricots, home grown and home canned.*

In January, 1918, at Madera, Calif., eight persons (two men and two women, three boys, and one girl) developed typical symptoms of botulism after eating home canned apricots which had a peculiar taste and six died.

The onset of symptoms of seven patients occurred on the second day and of one on the third day. Two of the children died on the third day, the two women and one child died on the fourth day and the remaining child on the fifth day after ingesting the poison. The two men recovered after an illness lasting several weeks.

Necropsy performed on one child within a few hours after death showed marked engorgement of vessels of meninges, and a few small hemorrhages on the surface of the pons. There were patches of broncho-pneumonia in the lungs, and hyaline masses containing clumps of leukocytes in some of the vessels. Bacteriologic examination of the spleen and of the contents of the large and small intestines was negative for *B. botulinus.*

The two patients who recovered were given a mixture of types A and B immune goat serums by subcutaneous injection on the sixth, seventh, and eighth days of the intoxication.

The apricots were unsaleable windfall fruit and the jar containing them had been marked for early use because of fear of spoilage. No unusual odor was noted, but the fruit had a peculiar sharp taste.

Twenty-five chickens, one turkey, and a wild canary died after eating the discarded fruit. *B. botulinus*, type A, was recovered from the crop of one of the chickens.

Reported by Dickson. Arch. Int. Med., October, 1918, vol. 22, pp. 487–490.

(d) CORN.

REPORT 6.—*Corn, locally grown and home canned, cold-pack method.*

In January, 1917, at Corning, Calif., one adult female opened a jar of corn which appeared spoiled. Because of a cold she did not detect any unusual odor, but when she tasted the corn, she noted a biting or bitter taste.

Typical symptoms of botulism developed in 24 hours, but the patient recovered.

A number of chickens ate the discarded corn and developed typical fowl botulism. Many of them died. *B. botulinus* was recovered from the remnant of the corn but was not typed.

Records of the laboratory of the bureau of communicable diseases, California State Board of Health, Berkeley, Calif.

(e) OLIVES.

REPORT 7.—*Minced olives, commercially canned.*

In February, 1920, at Richmond, Calif., two persons, husband and wife, consumed minced olives in which they noticed nothing unusual in the taste or odor. On the day following the meal, the wife developed typical symptoms of botulism and died on the fifth day. The husband, who also ate some of the olives, but not as much as his wife, was not ill.

At necropsy, there was congestion of the viscera and a few petechial hemorrhages on serous surfaces. Characteristic thrombi were found in some of the vessels of the brain.

Antitoxin, types A and B, was given on the fourth day after the poisoning without beneficial results.

The minced olives were canned at Stockton in 1919. The empty can was recovered from the garbage can, and from washings of the can, botulinus toxin, type A, was demonstrated in three laboratories, and *B. botulinus*, type A, was isolated.

Investigated by the commission. Referred to by DeBord, Edmonson, and Thom. Jour. A. M. A., 1920, vol. 74, p. 1220.

B. Clinically Typical Cases, Single or in Groups and Families—Causative Food Assigned on Epidemiological Grounds Only.

(1) PLANT PRODUCTS.

(a) STRING BEANS.

REPORT 8.—*String beans, commercially canned.*

In May, 1910, at Oroville, Calif., four tramps robbed a grocery store, carrying away some canned string beans which were swells and definitely spoiled.

Typical symptoms of botulism developed and all the tramps died; two on the third day and two on the fifth day of illness. The hospital diagnosis at the time was cerebrospinal meningitis, but the clinical picture as shown by case records was typically botulism. No bacteriologic tests were made.

From case histories in the county hospital at Oroville, Calif.

Investigated by J. C. Geiger.

REPORT 9.—*String beans, locally grown and home canned.*

In Amador County, Calif., about 1912, six persons became ill and five died after eating home-canned string beans. The symptoms were those of botulism. Bacteriologic tests were not made.

Personal communication from Dr. La Forrest E. Phillips, Palo Alto, Calif. Reported by Dickson. Jour. A. M. A., 1917, *69*, p. 966.

REPORT 10. *String beans, home grown and home canned.*

In November, 1913, at Stanford University, California, 24 young people ate a meal at which bean salad was served. Two cans of beans had been used in preparing the salad, one commercially canned and one home canned, but their contents were easily distinguishable by their color. No unusual taste or odor was noted, but it was stated that the home canned beans were very tender.

Twelve students, 11 women and 1 man, became ill with symptoms typical of botulism, and 1 died. The onset of symptoms occurred as follows: 2 within 24 hours, 3 on the second day, 4 on the third day, and 4 on the fourth day after the meal. The patient who died showed symptoms on the second day and died on the fourteenth day after ingesting the poison. Of the 11 persons who recovered, 2 were only slightly ill and did not consult a physician, and 6 were treated by Dr. T. M. Williams, Palo Alto, Calif. Two patients were discharged from the hospital on the twenty-first day, 3 on the twenty-third day, and 1 on the fortieth day. All the survivors were apparently well in from four to eight weeks and all had returned to their university work within two months.

Necropsy was performed in the fatal case and showed hyperemia of the cerebral vessels and of the abdominal and thoracic viscera. The lungs showed areas of bronchopneumonia.

On microscopic examination Professor Ophüls observed peculiar cellular thrombi in the blood vessels of the meninges and brain, but no destruction of the finer structures of the ganglion cells was seen.

Anerobic cultures of the contents of the large and small intestines, cerebrospinal fluid, spleen, and heart's blood showed no growth of *B. botulinus*.

The beans were grown near Napa, Calif., and were canned at home, being processed by immersing the cans into boiling water for one hour on each of three consecutive days. None of the beans which were served were available for bacteriologic examination, but of two cans which were of the same lot, the contents of one were sour and contained viable spore-bearing bacilli which did not produce toxin.

Reported by Wilbur and Ophüls. Arch. Int. Med., 1914, vol. 14, p. 589. Additional notes by Dickson. Monograph of Rockefeller Institute, No. 8, 1918, p. 17.

Report 11.—*String beans, locally grown and home canned.*

In July, 1916, a woman at San Pasquale, Calif., noted that one jar of string beans which she had canned two weeks previously was leaking. She tasted one of the pods and noticed it was "slightly sharp," and when she began to "heat them over," that a strong disagreeable odor was given off. She then discarded the lot. Three days later she developed typical symptoms of botulism, but recovered after an illness of about two months. Seven months later she noticed that she became tired and hoarse after talking for some time.

A number of chickens which ate the discarded beans developed fowl botulism and about 25 died. There was no material for bacteriologic examination.

Reported by Dickson. Monograph of Rockefeller Institute, No. 8, 1918, p. 29.

Report 12.—*String beans, locally grown and home canned.*

In February, 1918, at Los Angeles, Calif., a woman noted an unusual taste in beans which she had canned during the previous summer and which she attributed at first to the presence of lemon juice which had been added at the time of canning. After tasting four pods, she concluded that the beans were spoiled and discarded them.

On the following day typical symptoms of botulism developed and she died on the third day after tasting the beans. Necropsy was not obtained.

A portion of the beans was recovered from the garbage can several days after they had been discarded, but bacteriologic examination failed to demonstrate *B. botulinus.*

Reported by Dickson. Arch. Int. Med., 1918, vol. 22, p. 491.

Report 13.—*String beans, home grown and home canned.*

In February, 1918, at Oakdale, Calif., a woman tasted one pod from a jar of string beans which had been given her by a neighbor who grew and canned them during the previous summer. She noted a peculiar irritating taste, but swallowed a portion. When she heated the beans, a very disagreeable odor was given off.

On the following day typical symptoms of botulism developed and the patient died on the fourth day after tasting the beans. Necropsy was not obtained.

The beans had been picked in the early morning within a few hours of the time they were canned. Twelve jars were prepared, and of these nine had been eaten after cooking without ill effect. In only two jars of the lot were the contents spoiled.

A portion of the discarded beans was recovered from the garden after they had lain in the rain for several days. *B. botulinus* was not isolated from them. The one remaining jar was also examined but neither toxin nor living bacteria were demonstrated.

Reported by Dickson. Arch. Int. Med., 1918, vol. 22, p. 490.

Report 14.—*String beans, locally grown and home canned.*

In May, 1918, near Fresno, Calif., a woman developed typical symptoms of botulism after eating home-canned string beans and died several days later.

Clinical and laboratory data are not available.

Personal communication from Dr. St. John Hely, Madera, Calif.

Report 15.—*String beans, home grown and home canned.*

In December, 1919, at San Rafael, Calif., a family of four (father, mother, boy aged 3, and girl aged 5) ate home-canned string beans direct from the jar as salad. There is no record that the beans were spoiled or that there was an unusual odor, but it is noted that they were not soft.

On the second day after the meal, typical symptoms of botulism developed in all four persons and the two children died on the fourth day, the mother on the fifth day. and the father on the seventh day after ingesting the poison.

A mixture of types A and B antitoxin was given to the father and mother without affecting the course of the intoxication. The mother received 50 cc. of each type intravenously and 50 cc. of each intramuscularly on the fourth day, but died on the fifth. The father received similar injections on the fourth day, 100 cc. of each intraveniously on the fifth day, and 50 cc. of each intravenously on the sixth and seventh days, but he died on the evening of the seventh day.

Necropsy was performed in one case and cellular thrombi were demonstrated in the blood vessels of the brain. Cultures of the spleen and of the contents of the large and small intestines were negative for *B. botulinus.*

The beans had been grown at home and canned by the cold-pack method about three months before they were consumed. A portion of the beans had been cooked and served two weeks previously and had been consumed without ill effect. None of the beans were available for examination, but the contents of another jar which was obtained from the cellar did not contain *B. botulinus* or its toxin.

B. botulinus, type A, was recovered from the soil in which the beans had grown.

Investigated by the commission.

REPORT 16.—*String beans, home grown and home canned.*

In December, 1919, at Los Angeles, Calif., a woman tasted home-canned string beans which had spoiled. Thirty-six hours later she developed typical symptoms of botulism and died on the fifth day. Necropsy was not obtained.

The beans were grown at home and canned by the cold-pack method in September, 1919. None of the beans were available for laboratory tests.

Investigated by the commission.

REPORT 17.—*String beans, purchased in open market and home canned.*

In January, 1920, at Los Angeles, Calif., a woman opened a jar of string beans and tasted the contents. There was no apparent spoilage, and no unusual odor or taste was detected. She boiled the beans for from 35 to 50 minutes and served them to her three sons, who consumed them all.

On the following day the mother developed symptoms which were believed to be due to "bulbar paralysis," and she died on the fourth day after tasting the beans. The symptoms and course of her illness were typical of botulism. Necropsy was not obtained.

None of the three sons who ate the cooked beans developed any symptoms of illness.

The beans were purchased in the open market in October, 1919, and canned at home. No material was available for laboratory tests.

Investigated by the commission.

REPORT 18.—*String beans, locally grown and home canned.*

In April, 1920, at Los Angeles, Calif., a woman opened a jar of string beans which appeared spoiled, and she tasted a portion of two of the beans to verify the spoilage. On the following day she developed typical symptoms of botulism and died on the sixth day. Necropsy was not allowed.

The beans were grown in the vicinity and were canned at home in November, 1919.

A number of chickens which ate the discarded beans developed typical fowl botulism.

No material was available for laboratory tests.

Investigated by the commission.

(*b*) OLIVES.

REPORT 19.—*Ripe olives, commercially canned.*

In February, 1920, at Los Angeles, Calif., a woman ordered ripe olives with sandwiches in a department-store restaurant. She noticed that the olives had an unusually bitter taste. (She was familiar with the taste of ripe olives.) In about 12 hours she developed acute gastro-intestinal disturbances with nausea and vomiting, and these symptoms were followed by the typical symptoms of botulism. She was ill for about three weeks, but recovered.

The olives were canned in October, 1919, but none were available for bacteriologic examination, as they had been destroyed immediately after the customer became ill.

Investigated by the commission.

Report 20.—*Minced olives, commercially canned.*

In October, 1918, at Napa, Calif., a mother and her daughter aged 9 consumed sandwiches which had been prepared from minced olives. There is no recored of any indication of spoilage. On the following day the child developed typical sypmtoms of botulism and died 14 days after eating the food. The mother first noticed symptoms on the fifth day after ingesting the poison, but the course in her case was more rapid and she died on the seventh day.

Necropsy was performed in both cases and cellular thromb were observed in the blood vessels of the brain in one.

The minced olives were commercially canned and bore the label of a Long Beach (Calif.) packer. A portion of the paste which remained in the can was infused in water and the infusion was injected into guinea pigs. All of the animals which were injected died of typical symptoms of botulism, excepting those which had been injected with the boiled infusion. Tests for the isolation of *B. botulinus* were not completed.

Reported by the commission.

Report 21.—*Minced olives, commercially canned.*

In December, 1920, at Los Angeles, Calif. (New Year's eve), a number of persons consumed sandwiches prepared from canned minced olives. Nothing abnormal in taste or odor was detected. Five persons, four men and one woman, became ill with typical symptoms of botulism, but all recovered. The onset of symptoms in four cases occurred on the third day and in one on the fifth day.

The olives were canned at Stockton, Calif., in October, 1919, and were of the same lot which was responsible for outbreak No. 7. None of the material from the original can was available for bacteriologic examination, but from other cans of the same brand. *B. botulinus*, type A, was isolated, although no toxin could be demonstrated in saline infusion of the canned product.

Investigated by the commission.

(*c*) Apricots.

Report 22.—*Apricots, home canned.*

In March, 1915, at Fallbrook, Calif., five persons consumed home-canned apricots which were known to be spoiled, since there was a mold on the surface and the contents of the jar were disclored for about half their depth. The upper portion of the apricot was discarded and the remainder was served. It was noted that the apricots had a peculiar bitter taste, which was not displeasing to some members of the family.

All those who ate the apricots developed typical symptoms of botulism and all died. In three cases the onset of symptoms occurred on the third day, in one on the fourth, and in one on the fifth day. Two of the victims died on the fourth day, one on the fifth, one on the sixth, and one on the eleventh day after ingesting the poison. Necropsies were not obtained.

The apricots were canned at home.

A number of chickens which ate the discarded food developed typical fowl botulism and seven of them died. A dog also became paralyzed in the hind legs but recovered. Bacteriologic examination of the viscera and blood of one of the chickens was made in the coroner's laboratory, but no *B. botulinus* was found.

Reported by Dickson. Monograph of Rockefeller Institute, No. 8, 1918, p. 23.

Report 23.—*Apricots, locally grown and home canned.*

In January, 1918, at San Bernardino, Calif., two women consumed home-canned apricots which "did not taste just right." Both developed typical symptoms of botulism and both died.

There is no record of the exact time the poisonous food was eaten, but both victims developed symptoms on the same day and died on the third day after the onset. Necropsies were not obtained.

None of the poisonous food was available for bacteriologic examination, but other jars of the apricots from the cellar contained neither *B. botulinus* nor its toxin.

Reported by Dickson. Arch. Int. Med., 1918, vol. 22, p. 486.

(*d*) PEARS.

REPORT 24.—*Pears, locally grown and home canned.*

In January, 1910, at Sawtelle, Calif., 12 persons (3 men and 3 women, 2 boys and 4 girls) consumed home-canned pears which had been preserved four months previously. It was noticed that bubbles of gas escaped when the jar was opened and that the pears were "not exactly sour, but they tasted sharp."

All the members of the family developed typical symptoms of botulism and 11 died. In seven instances the onset of symptoms occured within 24 hours and in five on the second day after ingesting the poison. Three victims died on the second day, 6 on the third day, and 2 on the fourth day after the meal. The only person who recovered was the one who merely tasted a small portion of the pear when she opened the jar.

Necropsy was performed in one case, but no record is included in the report. Bacteriologic tests are not recorded.

Reported by Peck. Southern California Practitioner, 1910, vol. 25, p. 121.

REPORT 25.—*Pears, home canned.*

In March, 1918, at Colton, Calif., a man ate a portion of home-canned pears which had a peculiar taste. There is no record of other persons having eaten of the same lot. On the following day the patient developed gastrointestinal disturbances, which were followed by the typical symptoms of botulism. At the end of three weeks he was much improved, although the eye symptoms persisted, and he eventually recovered.

Material for laboratory tests was not available.

Reported by Dickson. Arch. Int. Med., 1918, vol. 22, p. 492

(*e*) ASPARAGUS.

REPORT 26.—*Asparagus, home canned.*

In November, 1915, a woman at Sacramento, Calif., opened a jar of home-canned asparagus and, although it was "a little sour," she drank the juice. When she heated the stalks a peculiar odor was given off, and the son discarded the cooked material because it tasted spoiled.

About six hours after drinking the juice the mother became nauseated and vomited and later developed the typical symptoms of botulism. She died on the fourth day after ingesting the poison.

Necropsy was not permitted, and no material was available for laboratory tests. The son who tasted the cooked asparagus did not become ill.

Reported by Dickson. Monograph of Rockefeller Institute, No. 8, 1918, p. 25.

(*f*) CORN.

REPORT 27.—*Corn, commercially canned.*

In April, 1918, at San Rafael, Calif., a woman ate three tablespoonfuls of canned corn which had a metallic taste, although it did not appear spoiled and had no unusual odor. The corn had been "warmed up," but not boiled. In about 11 hours she became ill. Two children, who also ate some of the corn, complained of stomach ache and some diarrhea, but showed no further symptoms after a dose of castor oil. The course of the woman's illness was typically botulism, but not severe. She recovered.

The corn was commercially canned, supposedly in Ohio. A portion of it was fed to chickens by the local health officer and four died of typical foul botulism. The contents of the crop of one was examined by Mrs. G. S. Burke, but no *B. botulinus* was found. No further laboratory tests are recorded.

Referred to by Burke, Jour. A. M. A., 1919, vol. 73, p. 1079, and investigated by the commission.

(*g*) HOME-BREW.

REPORT 28.—*Home-brew liquor.*

In September, 1919, near Colusa, Calif., six men imbibed freely of home-brew, which had been prepared from various home-canned products. One of the men could not be located after the party. Two of the men had been drinking the liquor at frequent intervals for two days before the party and they both became ill on the day following, but the other three did not develop any symptoms until the third day after ingesting the poison. Two of the victims died on the seventh day and two on the ninth. The patient who recovered possibly owes his life to the fact that his wife gave him a very large dose of physic when he returned home.

Necropsies were not obtained.

The liquor was prepared by placing canned peaches, apricots, plums, grapes, and tomatoes in a vinegar barrel which they filled with water. The mixture was allowed to ferment for 10 days. The fruit had been canned at home four and five years previously. Analysis showed that the liquor contained from 11 to 15 per cent alcohol.

The laboratory tests were not conclusive, but little material was available for examination as the barrel of liquor had been emptied. A number of hogs on the ranch developed paralysis, suggesting botulism, and died presumably after having consumed the contents of the barrel.

B. botulinus was isolated from the soil in the garden where the fruit had been grown.

Reported by Kelley, California State Board of Health bulletin, October, 1919, vol. 15, p. 114.

Investigated by the commission.

(2) ANIMAL PRODUCTS.

(*a*) BEEF.

REPORT 29.—*Tamale (beef) source unknown.*

In May, 1899, at Los Angeles, Calif., a woman became ill with symptoms resembling botulism after eating a beef tamale which appeared to be good. The onset of symptoms occurred within 24 hours of the meal. During the course of the illness there were features which suggested intercurrent infection, but the patient eventually recovered.

No laboratory tests are recorded.

Reported by Lewis. Southern California Practitioner, 1899, vol. 14, p. 464.

REPORT 30.—*Beef.*

In November, 1902, at San Francisco, Calif., seven persons (three men, two women, and two whose sex is not stated) became ill in a boarding house after eating "tainted boiled beef." Three of the victims died. The recorded onset of symptoms occurred as follows: One within 24 hours, two on the second day, one on the third day, one on the fourth day, and one on the sixth day after ingesting the poison and the course of the illness was typical of botulinus intoxication. The three deaths occurred on the fourth, fourteenth, and sixteenth days.

Necropsy was performed in one case and engorgement of the capillaries of the medulla, pons and cerebellum and patches of broncho-pneumonia are recorded. There is no record of microscopic examination.

Reported by Jellineck. Pacific Medical Journal, 1903, vol. 46, p. 110, and California State Journal of Medicine, 1902-3, vol. 1, p. 121.

Report 31.—*Calf's-head vinegarette, home prepared.*

About eight years ago, at Los Angeles, Calif., a man developed typical symptoms of botulism and died. He believed his illness was caused by eating home-prepared calf's-head vinegarette. No laboratory data are available.

Reported to the commission.

(*b*) Pork and Beans.

Report 32.—*Pork and beans, commercially canned.*

In December, 1906, three persons (two men and one woman) developed typical symptoms of botulism after eating commercially canned pork and beans. It is stated that there was nothing abnormal in the appearance, taste, or odor of the beans. The onset of symptoms occurred within 24 hours in two cases and on the second day in one. One of the victims died on the fourth day and two on the fifth day after eating the beans.

A number of chickens were fed with the remnants of the beans and all developed typical fowl botulism; nine of them died.

Laboratory tests are not recorded.

Reported by Sheppard. Southern California Practitioner, 1907, vol. 22, p. 370.

(*c*) Pork.

Report 33.—*Ham, home cured.*

In October, 1917, at Los Angeles, Calif., two persons developed typical symptoms of botulism and died after eating home-cured ham. The onset of symptoms occurred within 24 hours and death occurred on the fifth and sixth days after ingesting the poison.

There is no record of laboratory investigation.

Reported to the commission.

Report 34.—*Sausage, commercially prepared.*

In January, 1915, at Los Angeles, Calif., two persons, man and wife, developed typical symptoms of botulism which were attributed to toxin in wiener-wurst. The onset of symptoms occurred within 24 hours and death on the eighth and thirteenth days after ingesting the poison.

Necropsy was performed in one case and congestion of the viscera noted.

There is no record of laboratory investigation.

Reported by Frost. American Medicine, 1915, N. S. 10, p. 85.

(*d*) Clams and Fish.

Report 35.—*Clam juice, commercially bottled.*

In October, 1913, at San Francisco, Calif., three men drank clam juice which was prepared in a saloon by adding hot water to bottled clam broth. Two of them developed typical symptoms of botulism and died on the third and fifteenth days after ingesting the poison. The third man showed no symptoms excepting a slight gastrointestinal disturbance.

It is recorded that the bartender drank from 20 to 30 drinks of mixed variety daily and that he had imbibed as much alcohol as usual on the day he drank the poisonous broth.

Necropsies were not obtained and no material was available for laboratory tests.

Reported by Bine. Boston Medical and Surgical Journal, 1917, pp. 177–559.

Report 36.—*Clam broth, commercially bottled.*

In 1912, at San Jose, Calif., two men developed typical symptoms of botulism after drinking clam juice in a barroom. One died.

No laboratory tests were made and no further data were available.

Reported to Dickson by attending physician in 1916. Jour. A. M. A., 1917, vol. 69, p. 966.

Report 37.—*Tuna, commercially canned.*

In February, 1918, at Los Angeles, Calif., a man tasted a portion of canned tuna which he found to be spoiled and consequently discarded it. About three days later he developed typical symptoms of botulism and died on the sixth day after tasting the tuna.

There is no record of necropsy and no material was available for laboratory examination.

On the day after the tuna was discarded, fourteen chickens died after an illness typical of fowl botulism.

Reported to the commission in 1921 by the attending physicians.

Report 38.—*Probably fish pickled in vinegar, home prepared.*

On July 7, 1921, at San Jacinto, Calif., a woman opened a jar of home-canned white beans which she tasted and discarded because they were spoiled. The beans were fed to a number of chickens. On the following day she opened one or more jars of home-canned pickled mackerel and herring which had a spoiled appearance and odor, notwithstanding which she tasted the contents of the jar before throwing them to the chickens. Two days later, July 10, the woman developed typical symptoms of botulism and died seven days after tasting the fish. Necropsy was not obtained.

On July 9, the day following that upon which the pickled fish was discarded, and two days after the beans were discarded, a number of chickens showed typical symptoms of botulism and 75 died within three days. A cat which is known to have eaten the fish, but presumably ate none of the beans, developed typical symptoms of botulism but recovered.

The fish had been caught on June 25 or 26, less than two weeks before the food was tasted and were prepared as follows: The fish were eviscerated, cleaned, washed in fresh and salt water, and then sprinkled with salt. They were then washed and cut into small pieces and packed into Mason glass pint and quart jars which had been boiled for 30 minutes in weak soda solution. There was no indication of spoilage at this time. In the jars the fish was covered with vinegar and salt and to some of them tomatoes were added. The covers were applied and the jars were placed in a cooker and cooked for five hours, presumably at a boiling point although there is some doubt as to whether that temperature was maintained throughout.

A number of chickens were sent to the laboratory for examination. *B. botulinus*, type A, was recovered from the contents of the crops, gizzards, and intestines of two chickens and botulinus toxin, type A, was demonstrated in the contents of the crops.

Investigated by the California State Board of Health, the Bureau of Chemistry, and the commission.

(*e*) Cheese.

Report 39.—*Cottage cheese, home prepared.*

In June, 1912, at Long Beach, Calif., seven persons developed typical symptoms of botulism and two died after eating home-prepared cottage cheese.

No laboratory data are available.

Reported to the commission by the attending physician in 1921.

C. CASES OF BOTULISM—CAUSATIVE FOOD UNKNOWN.

(*a*) ANATOMICALLY OR BACTERIOLOGICALLY PROVEN.

Report 40.—*Causative food unknown.*

In May, 1916, at San Francisco, Calif., a man developed typical symptoms of botulism and died on the fourth day after the onset of his illness.

The cause of the poisoning was not determined. Laboratory examinations showed leucocyte counts of 10,000 and 14,000. The cerebrospinal fluid contained 80 cells but the type was not stated in the report. The urine was clear until the third day of illness when albumin, hyaline casts, and red blood cells appeared.

Partial necropsy was performed and extreme congestion of the meninges and substance of the brain was noted. On microscopic examination cellular thrombi were observed in some of the blood vessels of the meninges.

Reported by Dickson. Monograph of the Rockefeller Institute, No. 8, 1918, p. 27.

REPORT 41.—*Causative food unknown.*

In April, 1921, near San Luis Obispo, Calif., an ex-service man became ill and was sent to the marine hospital at San Francisco. He died several days later. A diagnosis of epidemic encephalitis was made, but from a study of the records after the patient's death the symptomatology and course more closely resembled botulism.

Necropsy was performed and congestion of the brain and meninges and the viscera was noted. On microscopic examination, a few vessels were seen in the brain in which a slight perivascular infiltration was present. No cellular thrombi were found. On bacteriologic examination of the brain tissue, *B. botulinus*, type B, was recovered.

Reported by Geiger. U. S. Public Health Reports, 1921, vol. 36, p. 1663.

(*b*) CLINICALLY TYPICAL CASES.

REPORT 42.—*Causative food unknown.*

In 1913, at Hornbrook, Calif., a woman developed symptoms of botulism and died. No cause for the poisoning could be determined, but it was noted that she had been caring for a number of sick chickens just before her illness.

Necropsy was not performed.

Reported by Dickson. Jour. A. M. A., 1917, vol. 69, p. 966.

REPORT 43.—*Causative food unknown.*

In March, 1911, at Los Angeles, Calif., a man developed typical symptoms of botulism and died seven days after the beginning of the illness.

Necropsy is not recorded.

Reported by Frost, Amer. Med., 1915, N. S. 10, p. 85.

REPORT 44.—*Causative food unknown.*

In November, 1919, at Berkeley, Calif., three men students at the University of California developed typical symptoms of botulism but all recovered. No material for laboratory tests was available.

Reported by attending physician to the commission.

REPORT 45.—*Causative food unknown.*

In September, 1920, a family who were motoring through were obliged to stop at Corning, Calif., because of the illness of their daughter, aged 9. The symptoms were typical of botulism and the child was very ill, but recovered. There was no record of the child having eaten spoiled food and no other member of the family was ill.

Reported to the California State Board of Health and investigated by the commission.

Since 1889, a total of 45 instances of human botulism have been reported for the State of California. A total of 132 people, with 81 deaths, are involved in these observations. According to Table 2, 42 of the single or groups of cases occurred since 1910; in fact the majority of the outbreaks were recognized during the last five years.

TABLE 2.

Year.	Plant products.				Animal products.				Unknown.
	Home preserved.		Commercially preserved.		Home preserved.		Commercially preserved.		
	Bacteriologically proven.	Bacteriologically not proven.	Bacteriologically proven.	Bacteriologically not proven.	Bacteriologically proven.	Bacteriologically not proven.	Bacteriologically proven.	Bacteriologically not proven.	
1899–1909	0	0	0	0	0	1	0	2	0
1910	0	1	0	1	0	0	0	0	0
1911	0	0	0	0	0	0	0	0	0
1912	0	1	0	0	0	1	0	1	0
1013	0	1	0	0	0	0	0	1	1
1914	0	0	0	0	0	0	0	0	0
1915	0	2	0	1	0	0	0	1	1
1916	1	1	0	0	0	0	0	0	1
1917	2	0	0	0	0	1	0	2	0
1918	1	5	0	1	0	0	0	0	0
1919	0	3	0	0	0	0	0	0	1
1920	0	2	2	1	0	0	0	0	1
1921 (until June 30)	0	0	1	1	0	1	0	0	1
Total, 45	4	16	3	5	0	4	0	7	6
Bacteriologically and toxicologically proven	4		3		0		0		0
Not proven and inconclusive.	16		5						
Total, 45	20		8		4		7		6

It is significant that nearly one half of the reports deal with single, isolated cases, while the remaining 20 observations involve groups and families. The following explanation can be offered for this interesting fact: In eight of the records of single cases it is stated that the patient tasted the preserved food in order to confirm certain apparent signs of spoilage. In the majority of instances, the food, which was found unfit for consumption, was then discarded. Its poisonous character was subsequently proved either by the illness or death of the housewife or by the occurrence of botulism among the chickens, which had access to it. In two instances (reports 17 and 26) the spoiled food was boiled and later consumed by other members of the household without consequences.

AGE AND SEX DISTRIBUTION.

There is no evidence of any special predisposition at any age period. The age and the sex incidence in any outbreak seems to depend entirely upon the accidental distribution of those who ate the food. It is of interest to note that according to the single case reports more females were poisoned than males. This observation is readily explained by the fact mentioned above that the housewives tasted or sampled the spoiled food. The sex distribution for 115 cases can be summarized in the following formula:

$$\text{Children}:\text{Males}:\text{Females} = 1:3.13:3.46.$$

INTOXICATION RATE.

As a rule all who ate the poisonous food became ill. The recorded clinical cases in individual outbreaks often form 100 per cent of those consuming the food. In only two instances (reports 2 and 6) is it recorded that one person in each outbreak failed to develop symptoms after eating the spoiled vegetables or fruits. It seems reasonable to presume that the person in report 2 who escaped illness received beans only from the unspoiled jar. The case mentioned in report 6 is not readily explained. Either the toxin of *B. botulinus* was unevenly distributed in the rather dry compact mass of minced olives or the husband who claims to have eaten the same amount of relish as his wife possessed some resistance toward the poison. An uneven distribution of the toxin in the food is probably exceptionally rare, but Römer (5) reported the fact that several people who ate of the portion of a ham that had a normal appearance remained well, while those who consumed meat from the deep green-grayish discolored parts developed typical symptoms. These observations should be taken into consideration when the intoxication percentage is being estimated.

In comparison with the usual food infection and poisoning outbreaks, the botulism intoxication rate appears rather high. In outbreaks due to food intoxications and food poisoning 50 per cent and in some instances even 80 per cent or more of those consuming the food become ill; but inasmuch as very few careful epidemiological studies of food poisoning have been made, it is not unlikely that in these instances individuals or groups are overlooked who consumed the food without harm. The available data, therefore, do not permit of a comparison of the infectivity rate of food infections with the intoxication rate of botulism.

CASE MORTALITY RATE.

The number of fatal cases varies greatly in different outbreaks. In 20 group and family reports involving from 2 to 12 persons per outbreak, the mortality varied from 0 to 100 per cent. As a rule, more than 50 per cent succumbed to the intoxication. In 45 outbreaks, there were 132 cases with 81 deaths, or a case mortality rate of 61.3 per cent. For 39 outbreaks in which the causative agent was known, the mortality was likewise 62.4 per cent. For 3 outbreaks (reports 2, 3, and 5) definitely shown to be due to *B. botulinus* toxin, the case mortality rate was 61.9 per cent. It is not unlikely that the toxicity and the amount of the causative food consumed or better the actual quantitative intake of the poison influences the mortality rate, although there are probably several factors which control the rate of absorption and thus cause individual variations in the rapidity of onset and severity of symptoms. Concomitant ingestion of other microorganisms in the spoiled toxic food may also influence the death rate. In children the mortality rate is higher than in adults. It is not unlikely that a similar quantitative relationship between body weight, toxin intake and mortality exists, as has been observed in guinea pigs and mice.

According to Savage (6) the mortality in the British food-poisoning outbreaks does not exceed 1.5 per cent. Likewise in Germany, the mortality rate was for the years 1868–1898, according to Schneidemuhl (7) approximately 1.52 per cent. It is therefore obvious that botulism, in contrast to other forms of food poisoning, is characterized by an exceptionally high case mortality rate.

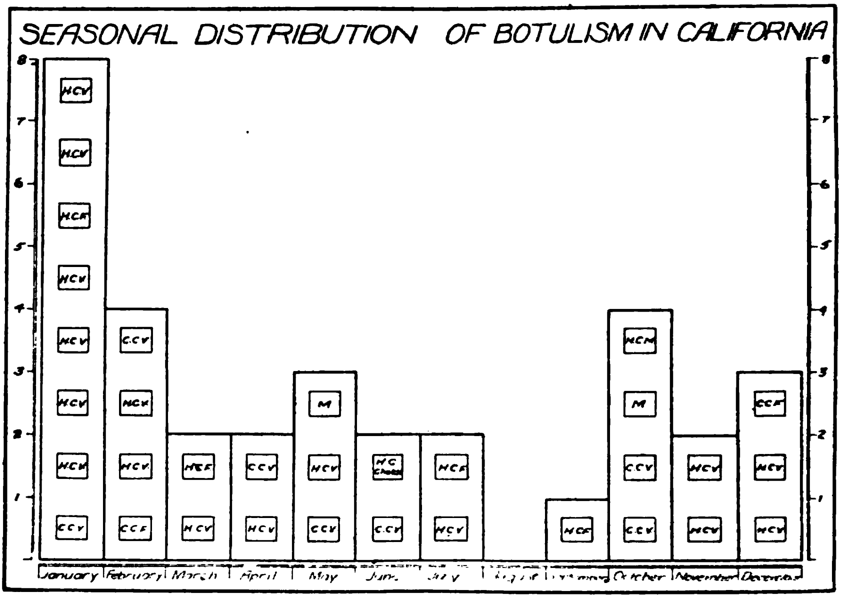


FIG. 2.—H. C. V., home canned vegetables; H. C. F., home canned fruits; C. C. V., commercially canned vegetables; C. C. F., commercially canned olives or fish; M., meat; H. C. M., home prepared meats.

SEASONAL DISTRIBUTION.

In California, more than one-half of all the botulism outbreaks have occurred during the fall and winter months, namely October–February. This fact is well illustrated in figure 2. In contrast to the bacterial food infections, which are usually prevalent during the hotter months, botulism bears no relation to the climate, because it is intimately connected with the consumption of preserved vegetables, string beans, corn, spinach and asparagus, pickled olives, and occasionally home-canned fruits (apricots and pears) which takes place during the winter season. How far the temperature of the subtropical summer climate of California influences the occurrence of botulism will be considered in connection with the discussion of the foodstuffs responsible for this intoxication.

FOODSTUFFS RESPONSIBLE FOR THE OUTBREAKS.

It has been pointed out repeatedly by Dickson that in the United States the majority of botulism cases are caused by the ingestion of canned vegetables or fruits in which the organism had grown and produced its toxin. This statement is borne out by the graphic presentation of the causative foods in figure 3. According to the reports in which the responsible food has been presumed to be the causative agent or has been toxicologically or bacteriologically proven, so 62.3 per cent of the outbreaks in California were due to home canned string beans, asparagus, corn, commercially packed ripe olives and spinach and home canned fruits (apricots and pears) while only 24.4 per cent were produced by animal products.

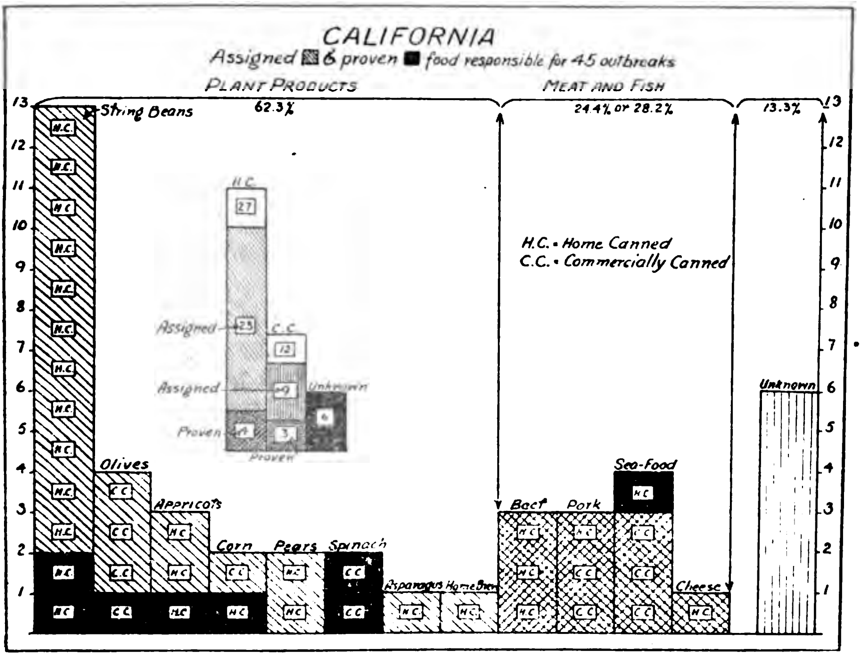


FIG. 3.

String beans played a very important rôle, a little less than one-half of all the outbreaks due to vegetable products followed the tasting or consumption of this food in a preserved state. Experimental studies have shown that string beans furnish an excellent media for the elaboration of a very potent toxin, and that spoilage of this vegetable when preserved is sometimes so slight that the housewife or cook will fail to detect it. Furthermore, canned string beans are frequently served cold as salads and any odor, which might arouse suspicion, is usually masked by the use of vinegar or mayonnaise dressing. Probably similar difficulties of detecting slight spoilage are responsible for the outbreaks due to minced olives. This relish is highly spiced and rather dry; it is consumed cold and volatilization of the fatty acids which would indicate spoilage is exceedingly slight in the first few hours following the opening of the can. Numerous laboratory examinations justify this statement.

It has been proven that *B. botulinus* can grow unaided in olives, spinach, corn, asparagus, beets, peas, artichokes, apricots, peaches. pears, prunes, and so forth, under certain conditions and cases of poisoning due to almost all of these products have been reported. However, it is exceedingly difficult to grow *B. botulinus* in the majority of fruits and some vegetables, if they are fresh and sound at the time of canning. In report 5, it is stated that the apricots were unsalable and windfall, "moldy" (report 22) or "obviously spoiled" (reports 23 and 24). Some observations also suggest that fermentation and toxin production due to *B. botulinus* occurs with much greater facility in the presence of concomitant anaerobes or even aerobes and fungi. Little need be said concerning the possible highly toxic properties of the so-called home-brew liquors. Fermenting mixtures of fruits and vegetables, provided a sufficient amount of water has been added, may favor the growth of *B. botulinus* and the formation of its toxin. It is therefore not unlikely that, as in report 28, some of the fatalities which have followed the drinking of undistilled home-brew liquors may have been due to the poison of *B. botulinus*. Toxicologists and prohibition officers should keep this possibility in mind.

On account of the high protein content, the suitable reaction and the degree of moisture, meat, fish and milk products can serve excellently as mediums for the development of *B. botulinus*. It is therefore rather surprising that in this series the number of cases due to these products is comparatively small. Unfortunately neither of these cases has been proven bacteriologically or toxicologically. In several instances (for example report 38) vegetable products were consumed at the same time and it is not unlikely that the food held responsible for the outbreak was not at fault. Furthermore, it is impossible to determine from the available records what contributory factors may lead to the elaboration of the *B. botulinus* toxin. In a few instances (reports 32, 36, 37, and 38) the products were canned while in others (reports 33, 34, 35, and 39) various other methods of preservation produced the condition suitable for the formation of the specific toxin. In every instance, regardless of the method of preservation, the foods were consumed either in a raw or imperfectly cooked state. From the data presented, it is evident that animal food products play a subordinate rôle in the botulism outbreaks of this country. Notwithstanding this, attempts have repeatedly been made to compare the local conditions with those in Europe.

It is not entirely clear why in European countries pork or meat products are the most frequent causes of botulism whereas in the United States preserved plant products are usually responsible, although it is a fact that in those portions of Europe where botulism is most frequent, there is a habitual consumption of uncooked, preserved meats and that in America canned vegetables and fruits, which have not been cooked after the removal from the container, are widely used as salad. It can therefore be stated that in all probability the differences in the tastes and dietaries of European and American people are responsible for the differences in incidence.

The case mortality rate varies somewhat according to the foodstuff involved in the outbreak.

TABLE 3.

Mortality from—	Number of outbreaks.	Number of cases.	Number of deaths.	Percentage.
Home canned string beans	5	33	18	54.4
Commercially canned spinach	2	7	3	42.8
Commercially pickled and bottled olives	4	9	3	33.3
Home-canned apricots	3	15	13	86.6
Home and commercially canned meat, fish, and milk	7	26	15	57.6

It is difficult to determine from the histories of the outbreaks the contributory factors which favor the germination of the spores of the toxicogenic bacillus. In another paper it will be definitely shown that *B. botulinus* is an organism of the soil. Spores of the organism are sometimes quite abundant, and any food product contaminated with soil may occasionally carry these potential elements. Moreover, it is well known from the work of Dickson and Burke, Weiss, and others that the spores of the majority of recently isolated strains are very resistant to heat. They share this property with other representatives of the group of proteolytic anaerobes. Any method employed in the preservation of food which fails to consider these facts is apt to favor spoilage, and consequently, in a certain small percentage of instances, the growth of *B. botulinus* and its toxin. It may therefore be stated without fear of contradiction that in the majority of outbreaks underprocessed, and therefore improperly preserved, nonsterile plant products have been the vehicles for the toxin. These conclusions apply to the commercially as well as to the home canned products.

Commercially pickled and bottled olives or factory-canned vegetables (spinach) were responsible for 6 outbreaks, while home-canned products were the causative food in 20 instances. The cold-pack method was frequently employed for the canning of vegetables and fruits at home, and in this series apparently was responsible for the death of 18 people. While there is no necessity of entering into a controversy relative to the economic merits of the two methods of food preservation, the epidemiologic observations have established the fact that even the commercial packing methods have been in few instances inadequate to insure freedom from botulinus poison. It is not surprising that the various home-canning procedures are inefficient when one realizes that the commercial canning industry, which for years has labored with improved machinery, a trained personnel, and in many instances with scientifically controlled processes has not entirely succeeded in eliminating spoilage and with it the occasional occurrence of botulism. From a public-health standpoint it is essential that all canning methods, whether commercial or at home, should aim at absolute sterility of the product to insure absolute freedom from *B. botulinus* and its toxin. In the light of recent studies this prerequisite does not offer unsurmountable difficulties, provided fresh and sound vegetables and fruits are used for preservation.

No information can be gained from these reports relative to the influence of salts, sugar, or organic acids. In one instance (report 12) it is stated that lemon juice had been added to the jar of string beans, yet the liquor was toxic and caused a fatal case of botulism.

The reports were also analyzed in order to detect any relationship between the toxicity and the time which elapsed from the act of canning and the tasting or eating of the preserved food. In the majority of instances the products had been preserved for from 2 to 26 months previous to consumption. In two cases (reports 11 and 38), however, it is stated that the canned string beans or fish were only two weeks old. Unquestionably the summer heat of July assisted in the production of the toxin. These facts also indicate that in some instances at least the germination of the spores, which had been subjected to heat during processing, was not retarded to any noteworthy degree. The commission is in possession of an epidemiological observation (see report 17 on botulism in chickens) which suggests that even in a period of three days sufficient toxin may be produced in a half-gallon jar of string beans, canned by the cold-pack method, to be fatal when fed to chickens. There is no evidence that food originally toxic may become nontoxic in the course of storage for several months, although in the light of recent laboratory studies such conditions might be expected. Future investigations dealing with the examination of spoiled food should carefully consider these facts, and such material should not only be tested toxicologically but also bacteriologically for the presence of *B. botulinus* spores. At times certain cans of spinach and olives belonging to the same lot, which was responsible for cases of botulism contained viable toxin-producing organisms, although no toxin was present. As the housewives or cooks who conducted the canning are usually among the first victims to die, many of the contributory factors which assisted in the elaboration of toxins in the preserved food could unfortunately not be ascertained.

PHYSICAL APPEARANCE OF THE INCRIMINATED FOOD.

The prevalent idea that the food must always be visibly spoiled in order to be toxic is not entirely supported by the available observations, although there is no doubt that in the majority of instances the canned product is so spoiled as to readily attract the attention of the one who opens the container. In order to emphasize this very important point, it is deemed advisable to tabulate the various statements as they appear in the history of the outbreaks.

TABLE 4.—*Home-canned vegetables and fruits.*

Report 1.—String beans: "Odor unpleasant."
Report 2.—String beans: "Taste not right."
Reports 9, 11.—String beans: Jar leaking. "Sharp biting taste; on cooking, disagreeable odor."
Report 12.—String beans: Peculiar taste attributed to lemon juice.
Report 13.—String beans: On boiling, disagreeable odor; peculiar irritating taste.
Report 15.—String beans: Beans hard and supposedly not spoiled.
Report 17.—String beans: No evident spoilage, no bad odor or taste.
Report 5.—Apricots: No odor, but "sharp taste."
Report 22.—Apricots: Top of jar moldy, lower portion tasting bitter.
Report 23.—Apricots: "Did not taste just right."
Report 6.—Corn: Spoiled, but odor not detected on account of cold. Taste bitter or biting.
Report 27.—Corn: No spoilage, no odor, but taste "metallic."
Report 24.—Pears: Obviously spoiled and taste not right.
Report 26.—Asparagus: A "little sour," on heating, offensive odor.

TABLE 5.—*Commercially canned vegetables and fruits.*

Report 3.—Spinach: Visible spoilage and repulsive odor on heating.
Report 4.—Spinach: Neither spoiled in appearance or taste or odor on boiling.
Report 7.—Minced olives: No odor or bad taste, but can emanated definite odor.
Report 19.—Minced olives: "Bitter or of unusual taste."
Report 21.—Minced olives: "No evident signs of spoilage."

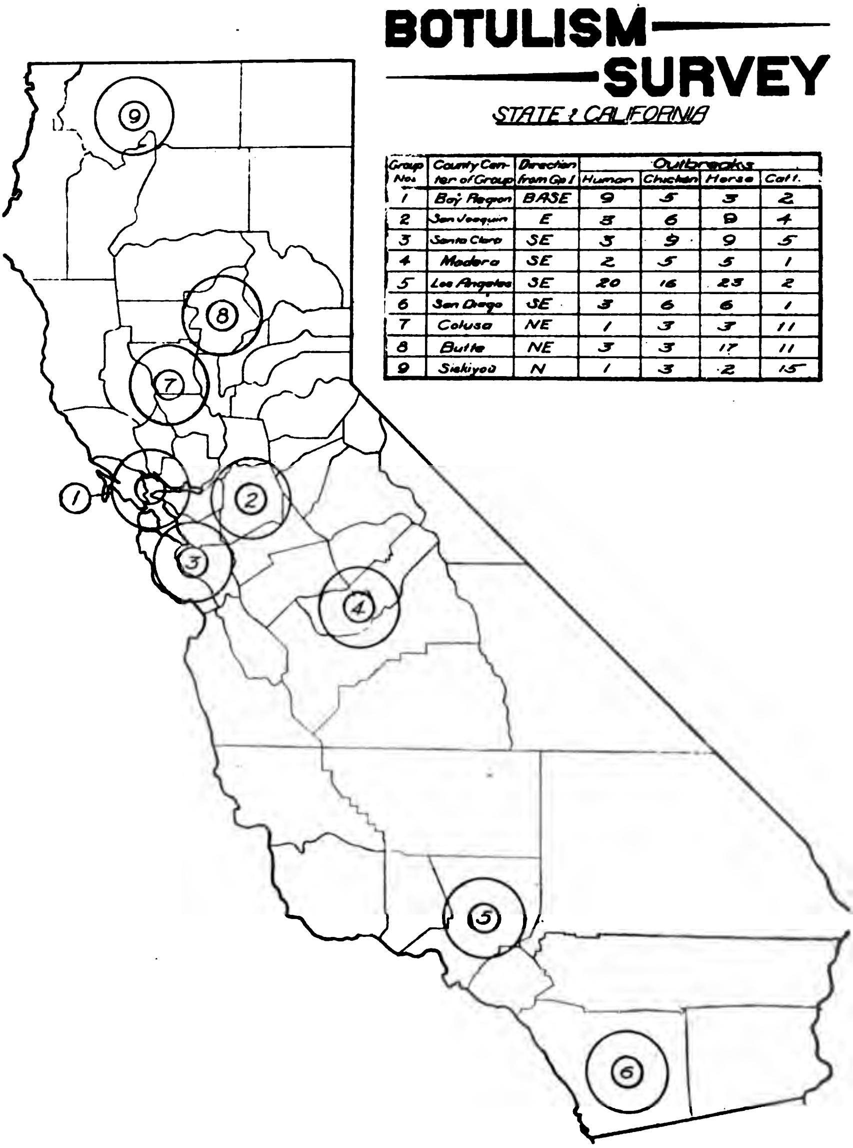
From the above tabulation (Tables 4 and 5) it must be concluded that in about one-half of the instances the spoilage of the preserved product was so striking as to attract the attention of the person opening the can, yet in some instances the disintegration of the contents was so slight that the housewife was prompted to confirm her impression by tasting it. As a rule she found the taste of the poisonous food to be abnormal or peculiar. In some cases the spoilage was not noticed until the food became heated during the process of cooking.

According to reports 15, 17, 4, and 21, macroscopic spoilage in the form of abnormal consistency or appearance was certainly not visible. These facts are supported by repeated observations made in several laboratories by independent workers. Several jars or cans of string beans, beets, asparagus, olives and so forth, may appear perfectly normal according to the verdict of a large number of persons familiar with the peculiar odor of anaerobic vegetable or fruit fermentation, although they contain a highly potent toxin. Food products containing a large amount of protein or starch, as peas, corn, fish and meat, are apt to show marked physical disintegration and other signs of spoilage in the form of leaking jars or bulging cans. It will be shown later that such food is usually considered unfit for human consumption, but it has in many cases been fed with fatal results to chickens. From the observations recorded in reports 15, 17, 4, and 21, it becomes evident that it is unwise to place absolute reliance on the dogmatic assertion that only food which is obviously unfit or putrid is liable to contain the toxin of *B. botulinus.*

In this connection, attention is called to the interesting observation recorded in report 4. Spinach, neither spoiled in appearance, taste, or odor, had been boiled for 20 minutes in fresh water and had been consumed by three people without any bad effect. The remainder of the vegetable was put aside, heated the next day and consumed by a woman who developed a mild attack of botulism. It is most likely that the interior portion of the boiled spinach still contained some poison, but it is also possible that during the lapse of a day in the warm climate sufficient toxin developed from the large number of spores which were originally in the under processed can and which survived the boiling. This observation is described in detail in order to emphasize how difficult the prevention of human botulism will be as long as unsterile, underprocessed canned products, which may contain viable spores of *B. botulinus* are being used by the public as food, although it must be stated that not all preserved foods can be processed until they are sterile, because the temperatures necessary to destroy the spores of thermophilic bacteria would render the food unmarketable. Preservation of any vegetable, fruit or animal product can only be regarded as safe, however, when spores of *B. botulinus* can not survive the processes. When once this prerequisite has been attained, the uncertainty and uneasiness which is felt by the consumer in judging or in deciding the ultimate disposal of an apparently sound or slightly spoiled can or jar of preserved food, will be completely eliminated.

GEOGRAPHICAL DISTRIBUTION.

A study of Figure 4 and its legend indicates that the outbreaks occur in all parts of the State, but that they are more frequent in the southern section. This localization is closely associated with the distribution of *B. botulinus* spores in nature, particularly in the soil. The relationship between prevalence of *B. botulinus* in the soil and the frequency of botulism is also illustrated by the fact that 23 outbreaks due to home-canned vegetables or fruits occurred in rural communities. Furthermore, the majority of the rural outbreaks were caused by home-canned products, while in the 6 urban outbreaks, as could be expected, commercially pickled olives and canned spinach were responsible. Most of the outbreaks due to animal or fish products occurred in cities. It is not unlikely that in all cases the causative food originated in the rural districts. The interesting observation that there may be a geographical localization of botulism in certain sections of a city or village (reports 16, 17, and 18) is partly corroborated by the recently proven prevalence of *B. botulinus* spores in the soil of these areas.



Group Nos	County Center of Group	Direction from Gp 1	Outbreaks			
			Human	Chicken	Horse	Catl.
1	Bay Region	BASE	9	5	3	2
2	San Joaquin	E	8	6	8	4
3	Santa Clara	SE	3	9	9	5
4	Madera	SE	2	5	5	1
5	Los Angeles	SE	20	16	23	2
6	San Diego	SE	3	6	6	1
7	Colusa	NE	1	3	3	11
8	Butte	NE	3	3	17	11
9	Siskiyou	N	1	3	2	15

FIG. 4.

PART IV.

HUMAN BOTULISM IN THE STATE OF WASHINGTON.

Several reports which appeared in the daily press indicated that botulism is not rare in the State of Washington. The commission has collected the reports dealing with two outbreaks in Seattle and with one case observed in Monroe. During the month of April, 1921, an intensive survey on botulism was conducted in the Yakima Valley. The report covering this investigation is presented in detail.

A. Single Cases or Those Occurring in Groups and Families, Proven by Bacteriological and Toxicological Tests.

REPORT 46.—*String beans, home canned.*

In February, 1921, at Seattle, Wash., a woman opened a jar of beans which was "gassy and foamy," had a pungent odor and a sour taste. Notwithstanding the apparent spoilage, she ate five or six small pieces and discarded the remainder. She developed typical symptoms of botulism within twenty-four hours and died on the third day after eating the beans. Necropsy was not performed. A maid also tasted one small piece of bean, but immediately spat it out because of the offensive taste. She did not suffer any ill effect.

The beans had been grown upon a farm near Seattle where one year before several hogs had been ill with symptoms resembling botulism and two had died. The beans were packed at home by the cold-pack method, and the victim stated that she had followed all directions explicitly. Spoilage was noted in a number of jars of beans and other home-canned products.

A rooster which had eaten some of the discarded beans developed typical fowl botulism.

A portion of the discarded beans was recovered from the garbage can. *B. botulinus*, type A, toxin was demonstrated and the bacillus isolated.

Investigated by Dr. C. R. Fellers, Seattle, at the request of the commission.

REPORT 47.—*Asparagus, purchased in open market and home canned.*

In November, 1917, at Seattle, Wash., three persons (two men and one woman) developed typical symptoms of botulism after eating home-canned asparagus, and all died. The symptoms in one case occurred within 24 hours; in the others there is no exact record. Death occurred on the fourth day after eating the salad.

Necropsy was performed in two cases, but after the bodies had been embalmed. There was marked congestion of the viscera and microscopic examination showed cellular thrombi in the vessels of both cases.

A number of chickens died after eating the discarded asparagus, and the contents of the crops contained *B. botulinus*, type A.

The asparagus had been purchased in the open market and canned at home by the method described in the pamphlet issued by the manufacturer of the glass jars which were used. When the first jar was opened, the asparagus was cooked but did not taste right, and the housewife told the maid to discard the lot. Instead of doing so the maid gave the remainder of the pack to a friend, at whose home the poisoning occurred.

When the second jar was opened, half the contents was cooked and eaten. None who ate the cooked asparagus became ill. The remainder was served after "warming up" on the following day to one man, who was the first victim of the poisoning. Four days later a third jar was opened and the contents served as salad to two persons, both of whom succumbed to botulinus intoxication.

The woman who opened the asparagus did not note anything unusual, and only one of the three victims detected any unusual odor.

Reported by Dickson. Arch. of Int. Med., 1918, *22*, p. 485.

REPORT 48.—*Spinach, locally grown and home canned.*

In May, 1919, at McKenna, Wash., three persons (father, mother, and adult son) developed typical symptoms of botulism after eating home-canned spinach. It was noted that the contents of the jar had a "bad scum" on the surface, but this was discarded and the remainder of the spinach "warmed up" and served. No unusual odor was detected when the spinach was heated, and no bad taste was noted.

All the patients developed symptoms within 24 hours after eating the spinach, and they died on the third, seventh and ninth days respectively.

No material was available for laboratory tests.

Reported to the commission.

B. Case Clinically Typical.

REPORT 49.—*Causative food unknown.*

In November, 1919, at Monroe, Wash., a man developed typical symptoms of botulism and died on the sixth day of illness. There was no record of what food was responsible for the poisoning, but commercially canned olives were suspected.

No material was available for laboratory tests.

Reported to the commission.

BOTULISM SURVEY IN THE YAKIMA VALLEY, STATE OF WASHINGTON.

During April, 1921, an outbreak of botulism from canned spinach, home prepared by means of a pressure cooker, occurred near Toppenish, Yakima County, Wash. At the request of the commission, this outbreak was investigated by Dr. C. R. Fellers, of the National Canners Association, attached to the laboratory of the Pacific Fisheries Investigations (Dr. E. D. Clark, director, Seattle, Wash.). The information submitted by Dr. Fellers as a result of his inquiry concerning the Toppenish outbreak was regarded of such importance that a complete survey of the Yakima suggested itself and was later carried out by a member of the commission.

The valley is geographically, in many respects, similar to certain parts of California. The country, though regarded as one valley and situated between rather high foothills of the Cascade Mountains, is really a series of three smaller valleys more or less constricted in area, which for convenience of a survey can be called the Tieton, the Yakima, and the Toppenish. The following geographical notes are of some interest:

Population, estimated	60,000
Total area (square miles)	4,112
Land under cultivation (acres)	140,000
Assessed valuation	$37,232,621

One hundred and thirty-two miles of graded and surfaced roads.

Live stock in country: Horses and mules, 16,000; stock cattle, 24,745; dairy cattle, 13,189; sheep, 138,608; hogs, 22,908; poultry, 172,980.

Mean annual precipitation, 8.35 inches, and snowfall 25.3 inches.

Fifty thousand acres of fruit trees, about one-half of which are in some state of bearing; 70 per cent apples, 10 per cent peaches, 10 per cent pears, and the balance prunes, cherries, plums, apricots, etc.

It is evident from this brief description that the Yakima Valley is one of the most productive and progressive agricultural and fruit-growing districts on the Pacific Coast.

According to the best available sources of information, there have occurred in the valleys during the last five years 7 outbreaks of human botulism, 27 outbreaks in domestic fowls, 26 in horses, 3 in cattle, and 1 in hogs. The mortality rate among the human cases was 50 per cent. Aside from being an important public-health problem, botulism assumes in the Yakima Valley also a noteworthy economic aspect, if one realizes that the loss in animals has been rather large, namely, 1,150 chickens, 143 horses, and 30 hogs. Inasmuch as the information collected extends only over a comparatively short period of time, there is no doubt that many other outbreaks have occurred and have been overlooked. The distribution of the outbreaks is shown in figure 6 and summarized in Table 6.

TABLE 6.

	Areas.		
	Yakima.	Toppenish.	Tieton.
Human	6	1	0
Chickens	10	1	16
Horses	5	12	6
Cattle and hogs	1	2	1

The human outbreaks which have occurred in Yakima are briefly abstracted below.

Cases Proven by Bacteriologic and Toxicologic Tests.

PLANT PRODUCTS.

REPORT 50.—*Corn, locally grown and home canned.*

In April, 1921, at Yakima, Wash., a woman tasted about one-half teaspoonful of home canned corn. She discarded the lot because it had a sour and biting taste. On the following day she developed typical symptoms of botulism and on the ninth day after tasting the corn she died.

Necropsy was not performed.

The corn was grown in the vicinity and canned by the cold-pack method. *B. botulinus*, type A, was isolated from the contents of another jar of the same pack.

Investigated by the commission.

REPORT 51.—*Corn, locally grown and home canned.*

In January, 1916, at Yakima, Wash., a woman swallowed about two teaspoonfuls of home-canned corn and discarded the remainder because it was spoiled. About 48 hours later she developed typical symptoms of botulism and died on the sixth day of illness.

Necropsy was not performed and no laboratory tests were made.

A number of chickens ate the discarded corn and all developed typical fowl botulism and died.

The corn had been grown in the vicinity and canned at home.

Reported to the commission.

REPORT 52.—*Corn, locally grown and home canned.*

In November, 1917, at Yakima, Wash, a woman opened a jar of corn which "had the top of the jar pushed out" and contained bubbles of gas. Notwithstanding the visible spoilage, she tasted a small amount and noted that it was bitter. Within two days she developed typical symptoms of botulism and died on the fourteenth day of her illness.

Necropsy was not performed.

A number of chickens consumed the discarded portion of the corn and all died of fowl botulism.

No laboratory tests were made.

Reported to the commission.

REPORT 53.—*Corn, locally grown and home canned.*

In December, 1918, at Yakima, Wash., a woman opened a jar of corn which was obviously spoiled. She tasted a portion of the corn and found it slightly sour. She boiled a portion of the corn for 30 to 40 minutes and while it was being heated she noted an unusual odor but nevertheless she gave it to two children. On the following day the mother developed typical symptoms of botulism but recovered, although there was transient blepharoptosis at times for nine months. The children did not show any signs of poisoning.

A number of chickens which consumed a portion of the corn which was discarded without having been cooked developed typical symptoms of botulism.

No laboratory tests were made.

The corn was grown in the vicinity and canned at home.

Reported to the commission.

REPORT 54.—*Asparagus, locally grown and home canned.*

In November, 1910, at North Yakima, Wash., a woman served "warmed" but not boiled home-canned asparagus at dinner. She had opened one jar and found it spoiled and with a bad odor but believed the next two jars to be good. Ten persons took asparagus on their plates, but as soon as the hostess tasted it she noted that it was spoiled and advised her guests to discard it. All but two of the party did so.

Of the 10 persons who had asparagus on their plates, it is known that 2 ate the whole portion, 2 men merely tasted the asparagus, and the remaining 6 ate only a portion of the gravy. Six persons, 2 men and 4 women, developed typical symptoms of botulism and 3 died. The 2 men who merely tasted the asparagus did not develop symptoms; an observation which was attributed to the fact that they both drank freely of beer after dinner. The onset in three cases was on the fourth, sixth, and eighth days after ingesting the poison. In the fatal cases, the illness lasted two or three days after the onset and in those which recovered there was no marked improvement for about three weeks.

Necropsies were not performed

A number of chickens which ate the discarded asparagus developed typical fowl botulism and died.

Reported by McCracken. The Leucocyte, Detroit, 1912, *16*, p. 80.

REPORT 55.—*Spinach, locally grown and home canned.*

In April, 1921, in the Toppenish area of Yakima, Wash., a man and his wife developed typical symptoms of botulism and died after eating home-canned spinach which showed no signs of spoilage and which tasted good. The onset of symptoms occurred on the first and second days, and death on the fourth and ninth days after ingesting the poison. In one case, the leucocyte count on the day of death was 16,000 and the urine was normal.

Necropsies were not performed and no laboratory tests for *B. botulinus* were made.

A number of chickens which ate the discarded spinach developed typical fowl botulism.

The spinach was grown in the vicinity and canned at home in an aluminum pressure cooker. The recommendations as to processing which were issued by the manufacturers of the cooker were closely followed.

Investigated by the commission.

ANIMAL PRODUCTS.

REPORT 56.—*Milk, commercially canned.*

In October, 1920, at Yakima, Wash., four persons (a man and his wife and two children, aged 4 and 3) developed typical symptoms of botulism after consuming spoiled canned milk, which was mixed with coffee. The onset of symptoms in one case, the father, was 24 hours and in the other three, 48 hours after the poison was ingested. All the patients recovered.

In many of the cans the milk was thick and would not flow from punched holes. It was the custom of the family to use the thickened milk if it had no bad odor, and it was from such a product that the poisoning was apparently produced.

None of the contents of the suspected can was available for laboratory tests, but bacteriologic examination of the contents of other cans showed that there was much sediment, thought to be dirt or manure, and that they contained viable bacteria. *B. botulinus* was not isolated.

Investigated by the commission.

PLANT PRODUCTS.

REPORT 90.[2]—*Asparagus, locally grown and home canned.*

In October, 1921, at Walla Walla, Wash., an adult woman opened a 2-quart jar of home-canned asparagus and tasted twice a portion of the content. About 48 hours later she developed typical symptoms of botulism and died on the ninth day after the tasting of the toxic food. Necropsy was not allowed.

The asparagus was heated and the son of the deceased tasted the product. He noted a "cheesy taste" and spit out part of the piece he tasted but swallowed part of it. He had no ill-effects.

The vegetables were grown locally and were canned in one and two quart jars during May or June of 1921. No detailed account of the method of canning was available, because the woman did the work alone; one daughter stated that the usual method was cold pack, boiled three hours in an open boiler and sealed hot. No preservative was used in canning except the usual salt seasoning.

One 2-quart jar had been used and had produced no ill effects. No part of the contents of the original jar tasted was available and the jar containing the food was broken and placed in the fire. It was not known that the product was spoiled until the poisoning occurred. Of the remaining six jars on hand, four showed evidence of spoilage; either discoloration, swelling of the lids, odor or all combined. Three of these jars submitted for examination showed marked evidence of disintegration of the stalks, leaking lids and repulsive odor. They all contained *B. botulinus* toxin, type A; the

---

[2] Reported since July 31, 1921.

M. L. D. varied between 1:10,000–1:50,000. *B. botulinus*, type A, was isolated directly from one jar in pure culture. Shake cultures of the liquor of the remaining jars gave numerous pure colonies of the specific organism. The liquor was still toxic after an exposure to a temperature of 80° for 30 minutes. The H-ion concentration of the toxic liquor of one jar (M. L. D. 1:10,000) was pH 3.82 and of the two others pH 6.28 and 7.35.

The heated asparagus was thrown out to the chickens, 23 of which died out of a total flock of 35.

Investigated by Mr. R. T. Elliott, Seattle station, Bureau of Chemistry. Bacteriological and toxicological studies made by the laboratory of the commission.

REPORT 91.[3]—*Corn, home grown and home canned.*

In October, 1921, at Yakima, Washington, an adult woman opened a jar of corn and tasted a portion of the contents which had a bad odor and appeared spoiled. She developed typical symptoms of botulism and died on the fourth day after the onset of the symptoms.

Necropsy was not allowed.

The case was diagnosed as poliomyelitis by an osteopath, but later seen by a deputy health officer and reported as botulism.

Nine chickens which ate the discarded corn developed fatal fowl botulism. The crop of one of the chickens contained *B. botulinus* toxin, type A, and the organism was isolated in pure culture.

Reported by Dr. H. H. Smith, health officer of Yakima; bacteriological and toxicological tests made by the commission.

In a general way, the botulism observations made in the Yakima Valley differ in no respect from those reported for the entire State of Washington, or for California. It is therefore only necessary to point out certain interesting peculiarities. The case mortality rate for the 13 outbreaks in Washington was 69.1 per cent, namely 18 deaths among 26 cases. Again botulism was only observed during the fall, winter, and spring months, from October until May; one-third of all the cases occurred during the month of November. The customary habit of consuming preserved vegetables during the seasons in which the fresh products are not available explains these facts.

TABLE 7.

Report.	Food.	Canning processes.			Spoilage.	Cases.	Amount consumed.	Laboratory proof.	Animals affected.
		Home.	Commercial.	Method.					
50	Corn	+		Cold pack.	+	1	2 teaspoonfuls		Chickens.
51	do	+		do	+	1	Tasted		Do.
52	do	+		do	+	1	do		Do.
53	do	+		do	+	1	Teaspoonful	+, type A.	
48	Spinach	+		do	±	3			
55	do	+		Pressure cooker.	No.	2			Do.
47	Asparagus	+		Cold pack.	+	3		+, type A.	Do.
54	do	+		do	+	6			Do.
46	String beans	+		do	++	1	3–6 small bean pods.	+, type A.	
56	Milk		+	Pressure	+	4			

---

[3] Reported since July 31, 1921.

The foodstuffs which were responsible for the botulism cases in Washington are graphically shown in figure 5, and the various factors accompanying the poisoning cases are summarized in Table 7. Ten of the reports state that home-canned vegetable food was responsible for the intoxications. In four of the seven instances in which single cases occurred the habit of tasting visibly spoiled food led to fatalities among housewives. Instead of string beans, corn was the most frequent cause. This vegetable is excellently suited for the development of a very potent poison and offers extreme difficulties in sterilization on account of the slow heat penetration in heavily filled jars. Furthermore, it is not unlikely that the repeated handling, which is necessary to prepare this vegetable for canning, assists in the contamination of the product with the spores of *B. botulinus*.

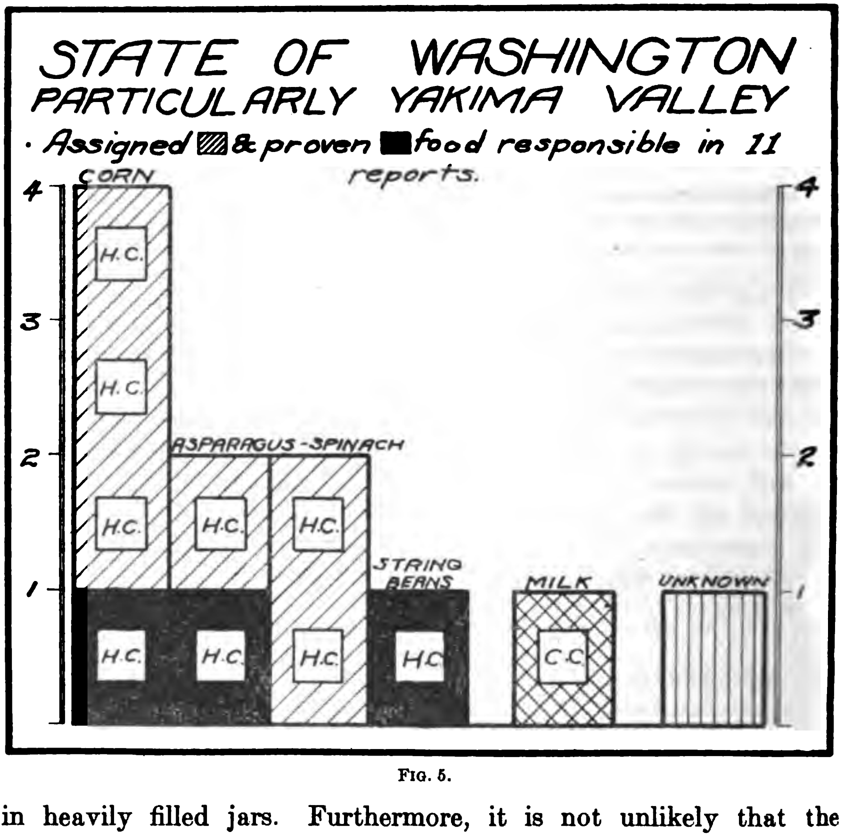


FIG. 5.

Spoilage of the causative food was recognized and admitted in all but one instance. In this particular outbreak, spinach which had been processed in a pressure cooker was assigned as the source of the poison. This observation lends additional support to the statement previously made that the degree of macroscopic spoilage of the preserved spinach in the form of changes in consistency and odor may be so slight as to escape the attention of the cook or consumer. Health officers, teachers in home canning and other agencies should direct their attention to these facts and proclaim their importance with unremitting insistence.

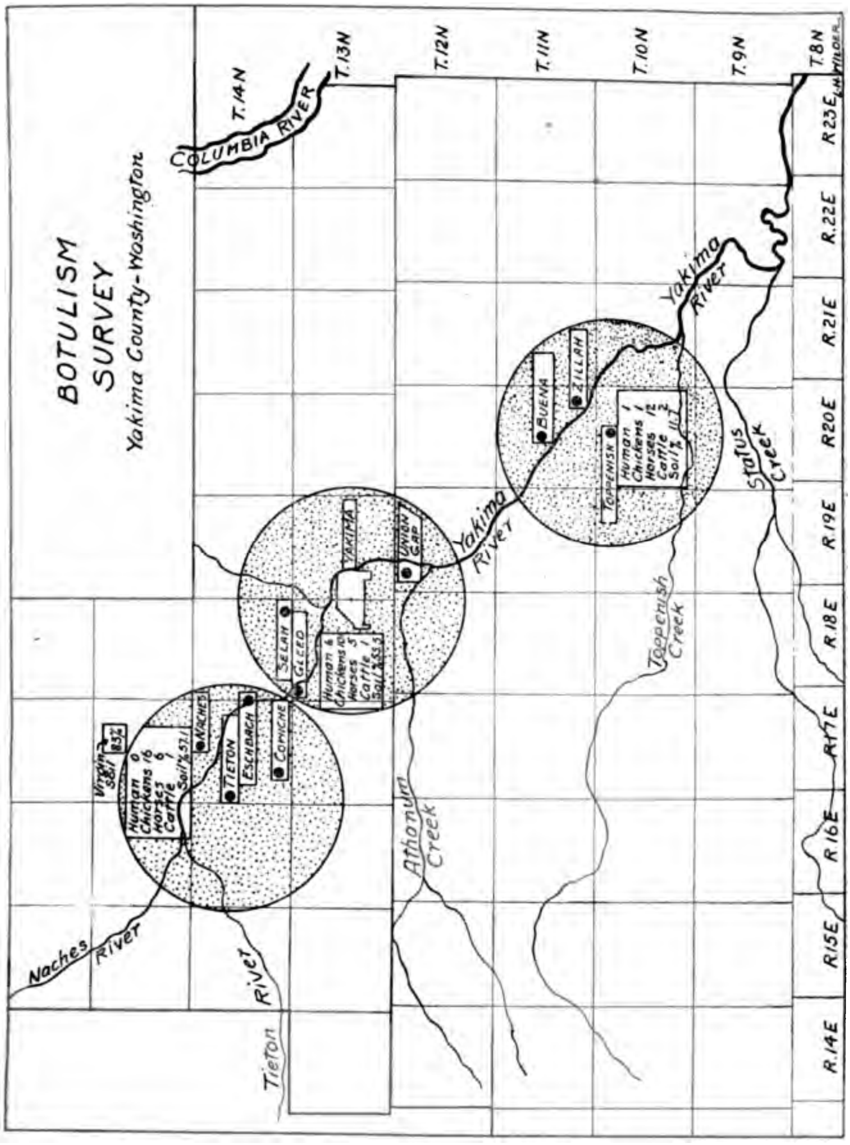


Fig 6.

Unfortunately, there were neither toxicologic nor bacteriologic tests to establish the responsibility of the evaporated milk, but the epidemiological data were so convincing as to leave little ground for doubt. Recent laboratory tests have shown that *B. botulinus* in pure culture does not grow freely in evaporated milk and it must be assumed that if the milk contained the toxin, there must have been some contributary factor in this case. There was no opportunity of investigating the contents of the can which is supposed to have caused the poisoning, but cans of the same lot were found to contain a sediment resembling dirt or manure, a condition of affairs which makes it obvious that the product would be difficult to sterilize and that there was every opportunity for the presence of other bacteria which may have played a rôle in making the milk suitable for the growth of *B. botulinus.*

In view of this outbreak, the milk-canning industry can not consider its products immune to the formation of the botulinus toxin and they should at once establish methods of procedure which would insure absolute cleanliness and sterility.

A bacteriological study of over 100 soil specimens collected in Yakima Valley explains the rather frequent development of *B. botulinus* in underprocessed home-canned vegetables and fruits. The percentage figures shown in figure 6 suggest that *B. botulinus* is in all probability an inhabitant of virgin soil. It may be mere coincidence due to methods of sampling but the available data indicate that from the mountain ranges toward the valleys following the descending course of the river, there is a progressive reduction in the infection of the soil. For example, virgin mountain soil contained *B. botulinus* spores in 83 per cent of instances, while earth collected in the adjacent Tieton and Yakima Valley sections gave 57.1 per cent and 55.5 per cent cultures. On the other hand, the Toppenish area, which is further removed from the source of the Yakima River, supplied comparatively few infected soil specimens (11.7 per cent). These facts suggest a number of important questions which can only be answered when intensive laboratory studies already in progress have been completed. However, observations made in California and Wyoming confirm the data collected in Yakima. They seem to indicate that *B. botulinus* is rather a common anearobe in mountain soil

PART V.

HUMAN BOTULISM IN THE UNITED STATES AND CANADA, EXCLUSIVE OF THE STATES OF CALIFORNIA AND WASHINGTON.

The commission has collected all the reports dealing with botulism which were accessible in the medical literature and daily press. A limited number of recent outbreaks were investigated by the commission and are reported here for the first time. In some instances personal communications of health officers have amplified the published reports. For the sake of brevity, the various reports are abstracted and only the most essential points which deserve discussion are mentioned.

A. Single Cases or Those Occurring in Groups and Families, Proven by Bacteriological and Toxicological Tests.

(1) PLANT PRODUCTS.

(a) RIPE OLIVES.

REPORT 57.—*Ripe olives, commercially bottled.*

In August, 1919, at Canton, Ohio, ripe olives were served at a table at which 18 persons were seated. It had been noted by a waiter that the vacuum of the container was lost and that the olives did not "taste right" and several of the guests remarked that they "smelled like limburger," "bit the tongue," "seemed to pucker the mouth," etc. Fourteen of the guests, the chef, and two waiters ate or tasted a portion of the olives and all but three developed typical symptoms of botulism. In general, it appeared that the severity of the intoxication and the rapidity of deaths was directly referable to the amount of olives ingested.

The 14 victims were all adults, 8 men and 6 women. Four men and 3 women died. In 1 case the onset of symptoms occurred within a few hours, in 6 on the first day, in 3 on the second day, in 2 on the third day, and in 1 on the fourth day after the olives were eaten. Four victims died on the third day, 2 on the fourth, and 1 on the eighth day after ingestion of the poison.

Necropsy was performed in two cases, but the viscera were examined only for chemical poisons.

It was noted that the two men who recovered had imbibed freely of whisky, and it is suggested that their survival might have been due to the action of the alcohol in destroying the toxin.

The olives were of the same pack as were responsible for outbreaks 58 and 60. Bacteriological investigation in several laboratories revealed the presence of botulinus toxin in the brine and viable *B. botulinus*, type A.

Reported by Armstrong, Story, and Scott. Public Health Reports, 1919, *34*, p. 2877.

REPORT 58.—*Ripe olives, commercially bottled.*

In October, 1919, at Detroit, Mich., ripe olives of the same pack as caused outbreak 57 were served at dinner. One of the guests remarked that the olives were soft and had a peculiar odor, but nevertheless four of the diners and one servant ate some of them. During the following three days, the son, aged 12, an adult daughter, and a waitress consumed the greater part of the olives; five women, one man, and one boy developed typical symptoms of botulism and three women, the man, and the boy died. One person who ate some of the olives escaped illness.

In only three cases was the consumption of olives limited to a single occasion so that the time of onset could be estimated, and of these one showed first signs of illness within 12 hours, one within 24 hours, and one, a mild case, 65 hours after ingesting the poison. One patient died in 24 hours, one in three days, two in four days, and one between five and six days after the first of the olives was eaten.

Necropsies are not reported.

Botulism antitoxin was administered on the fifth day to two patients, one who died and one who recovered, but subsequent tests proved that the type of antitoxin was not homologous with that of the toxin that caused the poisoning.

Portions of the olives and the brine were sent to several laboratories for examination and *B. botulinus*, type A, was demonstrated in all. A virulent toxin was also demonstrated in the brine.

Reported by Jennings, Haas, and Jennings, Jour. A. M. A., 1920, *74*, p. 77, and Emerson and Collins, Jour. Lab. and Clin. Med., 1920, *5*, p. 559.

REPORT 59.—*Ripe olives, commercially bottled.*

In January, 1920, at New York City, a woman opened a jar of ripe olives and presumably ate several. On the evening of January 9, she began to vomit and the next day she showed typical symptoms of botulism. She died the following day about 14 hours after the onset of symptoms.

Necropsy was not performed.

At the evening meal on January 13 a salad was served which contained ripe olives from the same bottle, and it was stated that several members of the family had eaten some of the olives while the salad was being prepared. The man who prepared the salad said that he had noticed nothing wrong with the taste or odor, but had found them "very good." Six persons (three men, two boys, and one girl) ate either the salad or whole ripe olives, or both, and all but the girl developed typical symptoms of botulism and died. The girl insisted that she had eaten none of the salad and only one olive, which tasted good. The onset of symptoms occurred 4, 22, 26 (two patients), and 50 hours after the food was eaten and death occurred 24½, 72, and 74 hours, respectively, after the onset of symptoms.

Botulinus antitoxin was administered intravenously in one case without beneficial effect. It was subsequently shown that the type of the antitoxin was different from that of the toxin which caused the poisoning. Antitoxin was also given as a precautionary measure to the girl who had not developed any symptoms of poisoning.

Necropsy was performed in one case but the details of the examination are not recorded.

The olives had been in New York since October, 1917. No evidence of spoilage was detected at the time the olives were consumed, but it is stated by the author of the report that in the laboratory it was noted that "the odor had a weak but apparently quite definite putrefactive tinge," although "there was considerable controversy in the laboratories in New York and Boston as to whether the odor present in the olives could be considered characteristic enough to be of protective value to the average individual."

B. botulinus, type A, was isolated from the olives remaining in the container and botulinus toxin was demonstrated in the liquid.

Reported by Sisco. Jour. A. M. A., 1920, *74*, pp. 516, 690.

REPORT 60.—*Ripe olives, commercially bottled.*

In February, 1920, at Memphis, Tenn., ripe-olive sandwiches were served at an afternoon party. Seven persons (two men, four women, and a boy) ate some of the olives and all died. The onset of symptoms occurred within 24 hours in four cases, on the second day in two cases, and on the third day in one. Two of the victims died on the second day, two on the third, two on the fourth, and one on the ninth day after ingesting the poison.

Necropsies are not recorded.

The olives were of the same pack as caused outbreaks 58 and 59. It is not noted that spoilage was detected. *B. botulinus*, type A, was isolated from the olives which remained.

Reported by Fontaine. Jour. A. M. A., 1920, 74, p. 470. Further data obtained from the Health Department of Memphis.

REPORT 61.—*Ripe olives (stuffed with pimento), Commercially bottled.*

In November, 1919, at Java, Mont., seven persons (four men, two women, and one little girl aged 5 years), ate stuffed ripe olives and all developed typical symptoms of botulism. Three men and two women died. The onset of symptoms occurred within 24 hours in two cases, on the second day in four, and on the third day in one. Death occurred on the third day in two cases, on the eighth day in two, and on the ninth day in one.

Necropsies were not performed.

The olives had been relabeled by the distributer. The only material which was available for laboratory tests was the glass container which was recovered on November 23, after being exposed in the snow. The United States Department of Agriculture reports that *B. botulinus*, type A, was isolated from dried pimento which was adherent to the glass.

Reported by De Bord, Edmonson, and Thom. Jour. A. M. A., 1920, 74, p. 1220.

REPORT 62.—*Ripe olives, commercially bottled.*

In June, 1921, at Greensburg, Pa., five persons ate ripe olives which, according to the statement of two of the victims and of the cook, did not appear to be spoiled. Two women who ate one olive each did not show signs of serious illness although one vomited after the meal, but three women developed typical symptoms of botulism and died. It is stated that the onset of symptoms in two cases occurred within 24 hours and that death occurred on the second, third, and fifth days, respectively.

Necropsies were not recorded.

Botulinus antitoxin (type unstated) was administered on the fourth day to one patient without beneficial effect. This patient was also kept under anæsthesia for three days prior to death.

It was stated in one laboratory that the olive brine was cloudy and had a "musty, rotten, molasses odor."

B. botulinus, type A, was isolated.

From the official report to the Bureau of Chemistry, U. S. Department of Agriculture.

(*b*) SPINACH.

REPORT 63.—*Spinach, commercially canned (processed by boiling for three hours).*

In January, 1921, at Grand Rapids, Mich., 29 persons (23 women and 6 men) developed typical symptoms of botulism and 3 died. The cause of the poisoning was subsequently shown to be commercially canned spinach which is said to have had no unusual odor or indication of spoilage although the taste was "biting." The onset of symptoms in 18 cases was within 24 hours, in 5 cases on the second day, in 2 on the third day, in 1 on the fourth, and in 2 on the sixth day after eating the spinach. Death occurred in 2 cases on the third day and in 1 on the fourth day after ingesting the poison.

Necropsy was performed in all fatal cases but the details of the examination are not yet recorded.

The spinach was of a pack which was processed at a temperature considerably below that of the ordinary trade procedure and in which there was a high per cent of spoilage. None of the original spinach was available for test, but *B. botulinus*, type A, was recovered from the contents of another can of the same lot. *B. botulinus*, type A, was also isolated from the stool of one of the victims which was collected on the eleventh day after the spinach was eaten, but in another stool collected on the thirty-first day no *B. botulinus* was detected.

Reported by Wells. Jour. Mich. State Med. Soc., 1921, *20*, p. 381. Additional data were given by Doctor Wells in a personal communication to the commission.

REPORT 64.—*Spinach, commercially canned.*

In January, 1921, at Battle Creek, Mich., five women developed typical symptoms of botulism and two died. It is stated that no common article of food could be traced and that "the only suspicious food was canned spinach, which was shown in a few instances to be infected, giving positive tests to type A."

There are no accurate data concerning the time of onset of symptoms but in the two fatal cases death occurred on the third and eighth day of illness.

Necropsy was performed in one case. It is stated that "colonies of bacilli which seemed to be *B. botulinus* * * * were noted in the walls of small gas cysts located in the pons and medulla."

The spinach was of a pack which had been processed below the standard of the trade. *B. botulinus*, type A, was recovered from some of the cans.

Reported by Colver. Jour. Mich. State Med. Soc., 1921, *20*, p. 385.

REPORT 65.—*Spinach, commercially canned.*

In February, 1921, at Mischawaka, Ind., two persons (a man and a woman) developed typical symptoms of botulism and died after eating canned spinach which was said to have shown no signs of spoilage and to have tasted normal. The onset of symptoms occurred within 24 hours and the patients died on the fifth day after eating the spinach.

Necropsies were not reported.

Antitoxin (type unknown) was administered without beneficial result.

Bacteriologic examination of the spinach revealed *B. botulinus*, type A, and virulent toxin.

Reported to the commission by the attending physician.

(c) CORN.

REPORT 66.—*Corn, locally grown and home canned.*

In October, 1915, at Hillsboro, Oreg., a woman opened two jars of corn which were obviously spoiled and had an offensive odor. She then opened a third jar which she thought smelled good, but when she tasted about one teaspoonful she decided it also was spoiled and discarded the lot. In about four hours she noted pain in the abdomen and on the following day she developed typical symptoms of botulism. She died on the fifth day after eating the corn.

Necropsy was performed but no cause of death was determined.

The corn had been canned at home several months previously. A number of hogs and chickens consumed that which was discarded and 50 chickens developed typical symptoms of fowl botulism and died. The hogs showed no signs of illness.

B. botulinus, type A, was isolated from the contents of the gizzard of one of the chickens.

Reported by Dickson. Monograph of the Rockfeller Institute, No. 8, 1818, p. 24.

(*d*) ASPARAGUS.

REPORT 67.—*Asparagus, home canned.*

In January, 1918, at Boise, Idaho, a salad prepared from cold home-canned asparagus was served at dinner. When the jar was opened, one of the guests remarked that it smelled spoiled, but the hostess replied, "It can't be; I canned it myself." One victim noted that it did not taste right.

Five persons partook of the salad and four developed typical symptoms of botulism and died, one woman, while being moved to the hospital in an ambulance. The onset of symptoms in three cases is given as within 18 hours after the food was eaten. Two persons died within 24 hours after the meal, and two others died within 48 hours after ingesting the poison. One man who "ate heavily of asparagus" escaped illness.

Necropsies are not recorded.

B. botulinus, type A, was isolated from the remnants of the salad and asparagus juice and extra cap of a container.

Reported by Thom, Edmonson, and Giltner. Jour. A. M. A., 1919, *73*, p. 907.

(*e*) BEETS.

REPORT 68.—*Beets, commercially canned.*

In May, 1920, at Florence, Ariz., five men (three Indians and two white men) ate uncooked commercially canned beets which were apparently not spoiled. All developed typical botulism symptoms and died. The onset of symptoms in four cases occurred within 24 hours and in one case within 48 hours after the poison was ingested. One man died on the second day, two on the third, one on the fourth, and one on the seventh day after the meal.

Necropsy was performed in one case and microscopic examination showed prethrombitic foci in the vessels of the brain.

Botulinus antitoxin, types A and B, was administered by intravenous injections in one case on the fifth day after the food was eaten, without beneficial results. Seventy cc. were injected.

B. botulinus, type B, was recovered from the wall of the jejunum of one of the victims who died.

Reported by W. E. Randall. Jour. A. M. A., 1920, *75*, p. 33. Also investigated by the commission and referred to in Public Health Reports, 1921, *36*, p. 1313.

(*f*) STRING BEANS.

REPORT 69.—*String beans, home canned.*

In February, 1918, at Decatur, Ind., two men, four women, and one boy ate home-canned string beans and all developed typical symptoms of botulism. There is no record that the beans were spoiled. The onset of symptoms in two cases occurred within 12 hours, in four within 24 hours and in one two days after the meal. The four deaths occurred on the fourth, sixth, seventh, and ninth days, respectively.

Homologous antitoxin was administered to three victims, beginning a little over eight days after the ingestion of the poison. One of the patients died a few hours after the injection and the other recovered.

Bacteriologic examination of the contents of the jar showed that the juice surrounding the beans did not contain virulent toxin, but *B. botulinus*, type B, was recovered from the spleen of one of the victims. (Graham.)

It is not recorded that any chickens ate of the beans, but in the Decatur Democrat of March 1, 1918, it is stated that a hog which had been fed garbage from the place where the poisoning occurred had developed signs of paralysis and died.

Reported by McCaskey. Amer. Jour. Med. Sci., 1919, *158*, p. 57. Additional data contained in a personal communication from Professor Graham, Urbana, Ill.

(2) ANIMAL PRODUCTS.

(a) Ham.

Report 70.—*Ham, preserved at home.*

In 1916, at Tampa, Fla., seven men developed typical symptoms of botulism and all died after eating a native "razorback ham, which did not have any bad appearance or odor." The onset of illness in all cases occurred within 24 hours after the ham was eaten; one man died within 18 hours and none lived beyond five days after ingesting the poison.

A portion of the ham was macerated in sterile salt solution and the liquid given to a cat. The cat developed typical symptoms of botulism and died. A similar result was observed in a dog to which a small portion of meat was fed. A mule was fed four ounces of tube and plate culture without effect. *B. botulinus* was recovered in pure culture from the ham.

Reported by Randall. Medical Record, 1920, *98*, p. 763.

(b) Sausages.

Report 71.—*Blood sausage, prepared at home.*

In 1912, at Lowell, Mass., two men, one woman, and one girl developed typical symptoms of botulism after eating homemade blood sausages, which were "boiled in water" before they were eaten. The onset of symptoms in all cases was within 24 hours after the meal. One of the victims died on the third day and one on the fourth and two on the fifth day after ingesting the poison.

Necropsies were not allowed.

The sausage was prepared from pork scraps and was packed into a casing prepared from the large intestine of a hog. *B. botulinus* was recovered from the sausage.

Reported by E. M. Randall. Medical Record, 1920, *98*, p. 763.

Report 72.[4]—*Summer sausage, commercially prepared.*

In December, 1919, at Milwaukee, Wis., three persons (two men and one woman) became ill after eating summer sausage, which had been purchased from a commercial packer. There is no record of any indication of spoilage. About one-half hour after the meal "all three became ill with nausea, vomiting, and gastrointestinal symptoms. The acute symptoms lasted for one day, gradually subsiding towards the end of the the third day."

A cat which ate the casing of the sausage showed similar symptoms, but recovered. On bacteriologic examination of the sausage, a spore bearing bacillus was isolated which was believed to be *B. botulinus*, but the recorded data concerning its formation of toxin are not convincing.

Reported by Church. Wisconsin Med. Jour., 1919–20, *18*, p. 377.

(c) Cheese.

Report 73.—*Cottage cheese, home prepared.*

In October, 1914, three persons became ill and died after eating homemade cottage cheese which had been stored in a tin bucket in the cellar. All showed typical symptoms of botulism.

Necropsy was performed in one case and was reported negative for poliomyelitis.

An emulsion of the cheese after incubation for 48 hours killed guinea pigs in 36 hours and *B. botulinus*, type B, was recovered in cultures from the cheese. It is stated that the cheese had a slight putrefactive odor due to the presence of *B. coli*.

Reported by Nevin. Jour. Infect. Dis., 1921, *82*, p. 226. Additional data were given the commission by the New York State Board of Health.

---

[4] The symptoms of the patients and the short duration of illness are not typical of botulism, and this fact, together with indefinite results of animal inoculation, suggests the possibility that the diagnosis of botulism was not fully justified.

B. Clinically Typical Cases, Single or in Groups and Families, Causative Food Assigned on Epidemiological Grounds Only.

(1) PLANT PRODUCTS.

(a) STRING BEANS.

REPORT 74.—*String beans, commercially canned.*

In 1915, at Basalt, Colo., five persons died after eating string beans. The symptoms were those of botulism. No clinical or laboratory data were available.

Reported by Curfman. Colorado Medicine, 1917, *14*, p. 35.

REPORT 75.—*String beans or spinach, commercially canned.*

In October, 1912, at Romley, Colo., six men and one woman developed typical symptoms of botulism and five of the men died, after eating canned string beans or spinach. The onset of symptoms varied from about eight hours to four days after the ingestion of the poison, and the deaths occurred in the fatal cases on the second, third, sixth, and fourteenth days after the meals. Convalescence of the two who recovered was prolonged and tedious.

Necropsy in one case showed congestion of the viscera, and thick mucus in the bronchi. Remnants of the beans and spinach were consumed by five burros, all of which developed typical symptoms of botulism and died. The contents of another can of spinach of the same lot was fed to a Belgian hare without producing symptoms.

Reported by Curfman. Colorado Medicine, 1917, *14*, p. 35.

REPORT 76.—*String beans, home canned.*

In December, 1917, at Ontario, Oreg., a woman opened a jar of string beans and tasted the contents to determine whether they were good. She decided they were "not exactly right" and discarded them. On the following day she developed typical symptoms of botulism and died about 52 hours after tasting the beans.

Necropsy was not performed.

A number of chickens ate the discarded beans and 39 of them died of fowl botulism within two or three days.

Reported by Dickson. Arch. Int. Med., 1918, *22*, p. 483.

REPORT 77.—*String beans, locally grown and home canned.*

In October, 1918, at Klamath Falls, Oreg., one woman tasted a portion of home-canned string beans which were obviously spoiled. Within 24 hours she developed typical symptoms of botulism and died on the fifth day after ingesting the poison.

A number of chickens ate the discarded beans and all died of typical fowl botulism.

No laboratory tests were made.

Reported to the commission.

REPORT 78.—*String beans, home canned.*

In March, 1918, at Newark, N. J., three persons became ill and two died after eating home-canned string beans as salad. The symptoms were typical of botulinus intoxication.

A number of chickens which ate the discarded beans died of typical fowl botulism.

Investigated by G. C. De Bord, Bureau of Chemistry, U. S. Department of Agriculture. Mentioned by Thom, Edmonson, and Giltner, Jour. A. M. A., 1919, *73*, p. 912, footnote 20.

(b) CORN.

REPORT 79.—*Corn, locally grown, home canned.*

In November, 1917, in New York State, seven persons (two men, one woman, and four children) ate succotash made from home-canned corn and fresh beans. One adult visitor refused to eat the vegetable because of the bad odor, and some who ate it are said to have pronounced it "bad." One person merely tasted it. The seven who ate the succotash developed typical symptoms of botulism and five died. The onset of symptoms occurred in four cases, three children and one adult, within 24 hours, and in one child on the second day after the meal. One of the victims died on the third day, three on the fourth, and one on the fifth day after ingesting the poison.

Necropsy was performed in one case and congestion of the viscera and hemorrhages of the intestines were noted.

No material was available for laboratory tests.

Reported to the commission.

Report 80.—*Corn, home canned.*

In January, 1920, at Pittsburgh, Pa., two men, one woman, and one boy developed typical symptoms of botulism after eating home-canned corn which tasted sour. The onset of symptoms in all cases was within 24 hours after the meal. Three of the victims died, one child on the third day, one adult on the eighth day, and one on the ninth day after ingesting the poison.

Clinical laboratory tests are reported as follows: Leucocyte count in one case, 6,700, with 71 per cent polymorphonuclear neutrophils, and in another, 8,300, with 73 per cent polymorphonuclears; spinal fluid in one case taken during life showed 3 cells per c. mm.; globulin test negative and Wassermann test negative; blood pressures registered 116/85 and 108/80 in two cases.

Blood serum of one patient was injected into animals without producing symptoms.

Necropsy was performed in all three cases and on microscopic examination the brains of two were negative but the brain of one showed hemorrhagic areas in the medulla and the lung of another contained hemorrhagic infarcts.

Anaerobic cultures from the liver, spleen, and feces in three cases, from the lungs and heart's blood in two, and from the brain in one were negative for *B. botulinus.*

Bacteriologic examination of the contents of another jar of the same pack showed viable spore bearing bacilli but no *B. botulinus.*

Reported to the commission by Drs. S. R. Haythorn and E. R. Lacy, William H. Singer Memorial Research Laboratory, Pittsburgh, Pa.

(*c*) Beets.

Report 81.—*Beets, home canned.*

In April, 1921, at Pueblo, Colo., two men, two boys, aged 13 and 9, and one girl aged 4, developed typical symptoms of botulism, and three of them died. The onset of symptoms in two cases, both of whom died, was within 24 hours, in two, one of whom recovered on the second day, and in one mild case on the third day, after the suspected food was eaten. The blood count in one case showed R. B. C. 4,850,000, leucocytes 8,800, polymorphonuclear neutrophiles 80 per cent.

Necropsies were performed, but the examinations have not been recorded in detail. In one case there was purulent nasopharyngeal discharge, hyperemia of the left hemisphere, and softening of the frontal lobe of the brain. Microscopic examination is not recorded.

Bacteriologic examinations of the brain of the victims were negative for *B. botulinus,* as was also a stool of a survivor, taken on the twenty-sixth day after the meal.

There was some question as to the cause of the poisoning, and the following table gives the details of the menu and the amount of various foods consumed by each person:

TABLE 8.

Name.	Age.	Chicken.	Potatoes.	Commercial canned corn.	Home-canned beets.	Dessert.	Status and treatment of case.
R. M......	28	+	+	+	+	+	Mild case; 20 cc. of serum, subcutaneously.
H. M......	13	+	+	+	+	+	Died.
F. M......	9	+	+	0	(1)	+	Recovered; 40 cc. of serum, subcutaneously.
Mrs. M....	25	+	+	0	0	+	Well.
Mrs. E....	26	+	+	+	0	+	Well; suspicious symptoms 6 days later; given 20 cc. of serum subcutaneously.
A. E.......	4	+	+	+	+	+	Died.
J. E.......	6	+	+	+	0	+	Well.
Mr. E.....	29	+	+	+	+	+	Died.

[1] Beet.

There can be no suspicion of the canned corn, because it was in a normal-appearing can, had no bad taste or odor and no appearance of spoilage and was cooked for at least 30 minutes before it was served. Moreover, the housewife tasted the corn before it was cooked and did not develop symptoms. The beets had been grown and canned at home by the cold-pack method and were the last of a lot of 12 jars, 11 of which had been consumed. No spoilage had been detected in any of them. They were contained in the half-gallon jar, and it was noted that the liquid was cloudy, but this was poured off and replaced by hot vinegar. The jar was not a swell, and no unusual odor was detected, even when the hot vinegar was added. One of the survivors, an adult, declared that the taste was remarkably good.

Investigated by the commission. Data pertaining to the post-mortem material incomplete, because the specimens for examination were lost in the Pueblo flood.

REPORT 82.[5]—*Possibly beets, commercially canned.*

In May, 1919, about 20 miles from Dawson City in the Yukon territory, Canada, 23 persons developed typical symptoms of botulism and 12 died after a meal at which Government-inspected cold-storage beef, commercially canned corn, beets, apricots, pears, and milk were served. In 10 cases the onset of symptoms occurred within 24 hours, in 5 on the second day, in 2 on the third day, in 2 on the fourth day and in 1 on the fifth day after the meal. One of the patients died on the second day, 1 on the third, 3 on the fourth, 3 on the fifth, and 1 each on the sixth, nineth, eleventh, and fourteenth days after the food was eaten. Of the survivors, 8 were seriously ill and 3 were mild cases.

There was no material for bacteriologic examination as the Northwest Mounted Police disposed of the meat and the camp surgeon was one of the victims and unable to make a personal investigation at the time. It was supposed that the meat was responsible for the poisoning, because all of the victims ate meat, some of it quite rare, whereas it was recorded that two victims had not eaten beets. However, there is evidence that at least some of the beets had a peculiar taste. The fact that all who ate the beets did not become ill could be explained by the fact that the contents of five tins were served.

Reported by Glancy (one of the victims.) Canadian Med. Assoc. Jour., 1920. *10*, p. 1027.

(*d*) TOMATO CATSUP.

REPORT 83.—*Tomato catsup, commercially bottled.*

In Cook County, Ill., two persons, man and wife, developed symptoms of botulism and were ill for several weeks although they ultimately recovered. Bacteriologic examination of the suspected catsup yielded an anaerobic spore-bearing toxin-forming bacillus which gave positive tests for *B. botulinus*. It was not typed.

---

[5] In the official report of these cases, it is stated that the cold-storage meat was believed to be the cause of the poisoning, but in the records it is noted that the canned beets had an unusual taste.

Personal communication by Graham, University of Illinois.

(*e*) SPINACH.

REPORT 84.—*Spinach, commercially canned.*

In April, 1920, in New York City, two persons, man and wife, developed typical symptoms of botulism and died. The onset of symptoms in both cases was within 24 hours after eating canned spinach in a restaurant. The husband said the spinach tasted good but the wife said her portion was "rotten." The woman died on the third day and her husband on the fourth day after ingesting the suspected food.

Botulinus antitoxin, "Nevin strain," type B, was administered to one case without beneficial result: 180 cc. were given intravenously.

Bacteriologic examination of the feces of the patients showed no *B. botulinus*.

No evidence of spoilage was detected in the spinach but it was of the same brand as that which caused the poisoning in outbreak 3. The spinach was removed from the can, cooked and kept warm by steam baths. It was stated by the proprietor of the restaurant that 18 other persons had been served spinach the same day and that none became ill.

Reported to the commission.

(2) ANIMAL PRODUCTS.

(*a*) CHICKEN.

REPORT 85.—*Minced chicken.*

In May, 1913, at Boston, Mass., one man developed typical symptoms of botulism from which he recovered after a tedious illness of more than six weeks. The onset of acute gastrointestinal disturbances occurred about two hours after ingestion of the suspected food. Minced chicken eaten in a restaurant was suspected of being responsible for the poisoning.

Laboratory tests were not made.

Reported by Stiles (the victim). Jour. A. M. A., 1913, *61*, p. 2301.

(*b*) HAM.

REPORT 86.—*Ham, commercially prepared.*

In June, 1920, at a summer resort in Maine, four persons (three men and one woman) developed typical symptoms of botulism and all died. The time of onset of symptoms is not stated, but the patients died on the third, fifth, ninth, and tenth day of illness, respectively.

The cause of poisoning was not determined, but it is known that all ate from the small end of a ham which had been purchased in the open market. Three of the victims stated that the ham had a bad taste.

Bacteriologic tests are not recorded.

Reported by E. M. Randall. Med. Record, 1920, *98*, p. 763.

REPORT 87.—*Smoked ham and salted pork, home prepared.*

"During November, 1919, at Sioux Rapids, Iowa, five persons became sick from eating smoked ham and salted pork kept in a barrel." Three of the patients died. In one case, which is recorded in detail, the patient was ill for over six weeks with an illness associated with fever as high as 104.2° F., and various symptoms of intracranial irritation, which are not characteristic of botulism.

Necropsy was performed, the anatomical diagnosis including fibrino-purulent basilar leptomeningitis, marked anemia and edema of the brain and anemia of the leptomeninges. Microscopic examination showed marked perivascular infiltration with lymphocytes.

Bacteriologic examinations of the exudate at the base of the brain and from the spleen were negative for *B. botulinus*. Cultures and feeding tests from the pieces of pork which remained in the barrel were negative for *B. botulinus*.

In view of the unusual clinical course and the character of the pathologic findings, as well as the absence of confirmatory bacteriologic evidence, there is justifiable doubt as to the correctness of the diagnosis of botulism in the case recorded.

Reported by Semerak. Jour. Infect. Dis., 1921, *29*, p. 190.

(3) CAUSATIVE FOOD UNKNOWN.

REPORT 88.—*Causative food unknown.*

In May, 1916, at Boston, Mass., a woman developed symptoms which strongly suggested botulism. After a tedious illness of several weeks she recovered. A diagnosis of botulism was made, but the carrier of the poison was not detected.

Reported by Lancaster. Trans. Amer. Ophthal. Soc., 1916, *14*, p. 648.

REPORT 89.—*Causative food unknown.*

In April, 1918, in New York City, one man developed symptoms which were diagnosed as botulism. He recovered after an illness of several weeks. The carrier of the poison was not detected.

Examination of the cerebrospinal fluid showed no increase in cells.

Reported by Grossman. Neurological Bulletin, 1918, *1*, p. 260.

Since 1912, 33 instances of botulism have been reported for the entire United States and Canada, exclusive of the States of California and Washington. A total of 187 people, with 114 deaths, are involved in these observations. According to Table 9, the majority of cases occurred during the last five years. Furthermore, the annual number of outbreaks definitely increased during and immediately after the war, which prompted the investigations on which this report is based.

TABLE 9.

	United States and Canada, exclusive of California and Washington.						California.		Washington.		Total.
	Home preserved.		Total.	Commercially preserved.		Total.	Home preserved.	Commercially preserved.	Home preserved.	Commercially preserved.	
	Bacteriologically proven.	Bacteriologically not proven.		Bacteriologically proven.	Bacteriologically not proven.						
1910	0	0	0	0	0	0	1	1	1	0	3
1911	0	0	0	0	0	0	0	0	0	0	0
1912	1	0	1	0	1	1	2	1	0	0	5
1913	0	1	1	0	0	0	1	1	0	0	3
1914	1	0	1	0	0	0	0	0	0	0	1
1915	1	0	1	0	1	1	2	2	0	0	6
1916	1	0	1	0	0	0	2	0	1	0	4
1917	0	2	2	0	0	0	3	2	2	0	9
1918	2	2	4	0	0	0	6	1	1	0	12
1919	0	1	1	3	2	5	3	0	1	0	10
1920	1	1	2	2	1	3	2	3	0	1	11
1921 until June 30	0	1	1	4	2	6	1	2	5	0	15
Total	7	8	15	9	7	16	23	13	11	1	....
	Or a total of 31 outbreaks. +2 unknown.						Total 36. +3 before 1910. +6 unknown.		Total 12. +1 unknown.		
Home preserved											48
Commercially preserved											31
Total											79

In contrast to the observations made in California and Washington, only 6 histories refer to single cases, while 25 reports consider outbreaks with 2 to 29 cases of botulism. The predominance of commercially canned foods, as olives and spinach, which were served at dinner parties, may account for these differences. It is, however, more likely that many single cases have escaped recognition and are therefore not available for consideration.

AGE AND SEX DISTRIBUTION.

As previously stated, there is no evidence of any special incidence of either sex or at any age period. The sex distribution can be summarized by the following formula:

Children : Males : Females = 1:9.1:7.1.

INTOXICATION RATE.

It is again definitely shown that the intoxication rate is very high. In five outbreaks, however, either one or several persons, who ate of the poisonous food, escaped without showing symptoms. The histories of outbreaks 58, 59, and 62 state that single individuals, each consuming one olive, failed to contract botulism. Report 67 mentions that one negro, who ate heavily of the asparagus, escaped illness. There is some dispute relative to the number of persons who consumed the commercially canned beets responsible for five deaths in Florence, Ariz. (report 68). According to Randall, nine people ate the poisonous vegetable, while the commission found only five men, in whose cases the evidence was conclusive that they had consumed the product.

In Report 62, it is stated that the woman who escaped illness after eating one olive, vomited immediately after the meal and it is assumed that she eliminated the poison in this manner. This explanation is not absolutely sound. Numerous histories mention initial vomiting notwithstanding which fatal botulism developed in the majority of the cases. The observation of Römer (2) suggesting an uneven distribution of the toxin in ham is supported by the facts detailed in report 86.

CASE MORTALITY RATE.

The number of fatal cases varied greatly in different outbreaks. In 33 observations there were 187 cases with 114 deaths, a case mortality rate of 60.9 per cent. According to Table 10, the case mortality is affected slightly by the foodstuffs responsible for the botulism cases. However, aside from the initial toxicity and the quantity of the poisonous food which has been consumed by the members of the groups or families, the form in which the toxic vegetables or meats have been served, either alone or with other food or reheated or washed before use, influences the mortality rate. Reports 57 and 63 support these general conclusions.

TABLE 10.

Mortality from—	Number of outbreaks.	Number of cases.	Number of deaths.	Percentage.
Commercially pickled and bottled olives	6	45	33	73.3
Commercially canned string beans (2) home-canned string beans (4)	6	24	18	75.0
Commercially canned spinach	4	38	9	23.6
Commercially (2) and home-canned (1) beets	3	33	20	60.0
Home-canned corn	3	12	9	75.0
Home-canned asparagus	1	4	4	100.0
Home-preserved ham and pork products	3	16	14	87.4
Home-preserved (1) and commercially preserved (1) sausage	2	7	4	77.1
Home-prepared cottage cheese	1	3	3	100.0

SEASONAL DISTRIBUTION.

The time of the year had no influence on the number of outbreaks. It is probably mere coincidence that 5 outbreaks occurred in January and also in October. Most of the botulism cases due to home-canned products developed in the fall and winter months for reasons previously discussed.

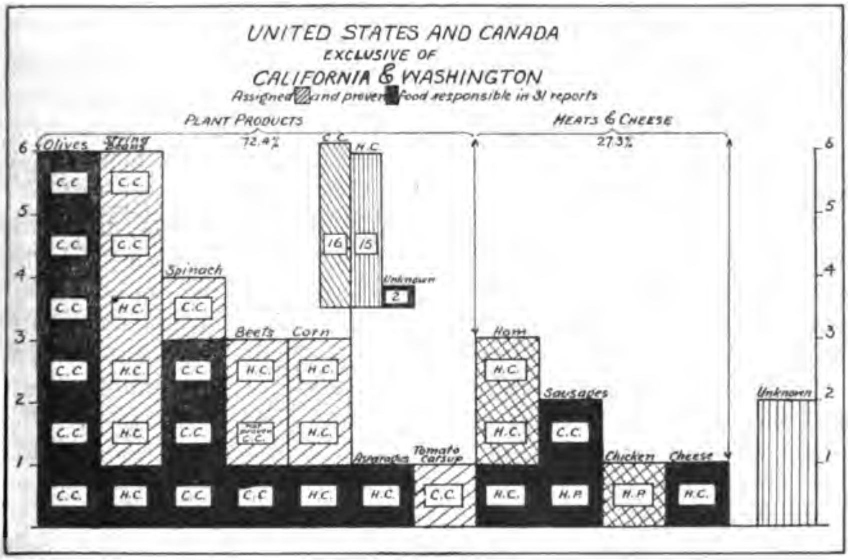


FIG. 7.

FOODSTUFFS RESPONSIBLE FOR THE OUTBREAKS.

The various foodstuffs either assigned as the cause or proven to have been responsible for the botulism in 33 outbreaks are shown in graphic form in figure 7. Plant products caused 72.5 per cent of the cases, while 27.3 per cent of the outbreaks must be attributed to animal products. Commercially bottled olives, commercially canned spinach and home and commercially canned string beans were responsible for one-half of the single or group and family cases. The commission had no means to verify the reports (72, 83, and 87) dealing with tomato catsup, sausages, and smoked ham and mentions the histories merely for the sake of completeness.

The commercially packed products, which were involved in 16 outbreaks, were grown and canned in the following States:

TABLE II.

California	9 outbreaks (6 olives and 3 spinach).
Kansas	1 outbreak (string beans).
Ohio	1 outbreak (beets).
Wisconsin	1 outbreak (sausages).
Unknown	4 outbreaks (1 spinach, 1 beets, 1 string beans and 1 tomato catsup).

The home-canned vegetables or meats which caused 15 outbreaks were grown and preserved in the States of Colorado, Florida, Idaho, Indiana, Iowa, New Jersey, Oregon, New York, and Pennsylvania.

Among the numerous causes which favored the persistence and multiplication of *B. botulinus* in home-canned foods, incomplete sterilization must be considered the most important factor. This statement applies also to the commercially canned ripe olives and spinach. Until quite recently, the processes involved in preserving ripe olives were briefly as follows:

The fruit was permitted to ripen on the trees, care being exercised to start picking before the olives were overripe. After the olives had been gathered by hand, they were transported to the packing plant, where they were sometimes held in dilute brine before they were cured.

In the factory, the olives were first sorted by sizes, then put through repeated washings and conditionings for variable periods depending on the quality and condition of the fruit, the seasonal temperature and the technical details in vogue in the particular plant. In some plants, the olives were kept in agitation during these procedures by means of the ordinary hand paddle, while compressed air jets served the same purpose under more modern practices. The olives were first immersed in clear water in cement or wooden vats for two or three weeks, in order to prepare the skins for the subsequent steps in the process. They were then subjected for from 8 to 12 hours to the action of a solution of caustic soda, 2½ ounces to a gallon of water. After exposure to the air until their coloring was uniform, the olives were again immersed in a solution of caustic soda 1¼ ounces to a gallon of water, for a period of from 8 to 12 hours. The second caustic treatment was to abstract the bitter properties of the fruit and was followed by washing in clear water until all traces of the lye had been removed. The olives were next immersed for one or two days in a brine solution, testing 9 or 10 points on the salometer

(2, 2–2.5 per cent salt) after which they were deposited in bins in the canning room. Women operators then packed them in cans, rejecting at this time all imperfect or soft fruit. The cans were filled with brine testing about 12 points on the salometer (3 per cent salt) at a temperature of 175° to 180° F. and were subjected to an exhaust process of 185° F. before sealing. The fruit was then cooked at 212° to 224° F. for from 12 to 30 minutes depending on the size of the containers and was permitted to cool naturally. No effort was made by any of the canners to control accurately the temperature of the solutions in the various processes.

In a news notice, which was published shortly after the Detroit outbreak, it was mentioned that no heat was used for preservation. This statement is incorrect. All canned and bottled olives have been subjected to heat ever since ripe olives have been canned in California, although until recently the process temperatures employed have been inadequate. Bacteriologic examinations of canned olives by Koser (8) and Rosenberger (9) have revealed the presence of non-spore bearing aerobic bacilli, cocci or members of the colon group even in a small percentage of normal containers; while many living organisms have frequently been obtained from samples which have been abnormal as indicated either by a swelled condition of the container or a bad odor.

In the light of this knowledge, it is truly surprising that only a few containers of bottled ripe olives (14) containing *B. botulinus* or its toxin have been found among the hundreds examined by various laboratories. Experimental studies have indicated that *B. botulinus* grows very poorly in ripe olives and it is quite possible that concomitant multiplication of other bacteria, yeasts or moulds exerts a growth-supporting influence. Variations in the concentration of the brine, prolonged improper preservation of the poorly picked fruit in unsuitable containers before canning may also be contributory factors in the botulism spoilage of olives. From the standpoint of prevention of botulism, however, these factors enact a subordinate rôle to that played by complete sterilization.

The present regulations of the California State Board of Health, which require that all ripe olives canned in brine must be processed at 240° F. for at least 40 minutes and that the brine must be of such concentration as will prevent excessive fermentation, are believed to insure an absolutely safe product.

Little needs to be said with regard to commercially canned spinach. The processing temperature of 212° F. for three hours or 240° F. for 90 minutes for heavily filled No. 10 cans (97 ounces "put in" or 87 ounces net weight) was wholly inadequate, particularly since it is now known that the spinach responsible for 4 outbreaks had been grown on heavily infected soil and had been inadequately blanched before canning. The spinach packers are now submitting their No. 10 cans, with a fill of 82 ounces, and an initial temperature at the center of the can of at least 110° F., to a minimum temperature of 252° F. for at least 90 minutes, and by this process have not only reduced spoilage to a minimum, which they were previously unable to attain, but have in all probability also eliminated *B. botulinus.*

No satisfactory explanation can be offered for the peculiar fact that five outbreaks due to commercially canned olives were recognized in rapid sequence in the course of seven months, although it is known that three were from bottles of the same pack. A similar wave of botulism cases due to spinach suggests that the notoriety given to the first cases prepared the minds of the medical men and health officers so that the poisonous food responsible for the cases was properly identified.

Nothing definite is known concerning the process temperatures employed in canning the commercial beets and string beans assigned as the causative food in reports 68, 74, and 75. When the home-canned vegetables are considered, it is at once noted that string beans and corn are the leading causes of botulism in other States as well as in California and Washington. Asparagus and beets preserved at home are likewise definitely connected with outbreaks.

Apart from the outbreaks due to pork products, the number of cases ascribed to animal foodstuffs is small. The preliminary treatment of the ham is not stated in reports 70 and 80, but it is known that the food was prepared at home. Report 73, dealing with the demonstration of poison in cottage cheese, finds its analogy in report 39 and forcibly calls attention to a food generally considered immune to *B. botulinus* spoilage. It would be of interest to know the character of the milk and the procedures which were employed in making these cottage cheeses. Some of the bacteria commonly concerned in the natural souring of milk, which constitutes the basis for the so-called cottage cheeses, have certain characteristics similar to those of *B. botulinus.* The decomposition products of all these organisms are similar, and without toxicological tests it will be indeed difficult to determine by the odor or by the consistency of the cheese whether or not *B. botulinus* has assisted in the ripening.

PHYSICAL APPEARANCE OF THE INCRIMINATED FOOD.

From the standpoint of safety to the consumer, it is important to know that in the majority of the outbreaks the causative commercially canned food was visibly spoiled. The odor of the olives was invariably declared to be distinctly peculiar, "limburger cheeselike," "musty," or "with a weak putrefactive tinge." In fact, it has been stated that a rancid, offensive odor is characteristic for *B. botulinus* spoilage of olives. Laboratory tests, however, have shown that it is impossible to select toxin containing samples from other spoiled samples without tests on animals. There is unfortunately a widespread lack of acquaintance with the normal odor of ripe olives, and the offensive odor may be reduced to a minimum by washing or icing of the preserved fruit. Any jar or container from which on opening there emanates a peculiar odor should be considered suspicious and the contents discarded. It is recommended that for the destruction of the toxin the contents be thoroughly boiled for at least one hour.

According to reports 63 and 80, canned spinach and beets may show very little spoilage, although they may contain a very potent toxin. The odor may appear normal even on heating, while the physical disintegration may be exceptionally slight. Cloudiness of the brine or liquor may be the only sign of bacterial activity. Indeed, the containers may appear perfectly normal and the absence of a swelled condition of the can may render detection of the spoilage even more difficult. This fact has been recently confirmed by Koser, Edmonson, and Giltner (10) on one can of spinach artificially infected with spores of *B. botulinus*. The home-canned vegetables mentioned in reports 66, 67, 69, 76, 77, 79, and 80 were definitely spoiled and would have been discarded by people who were familiar with the dangers of decomposed food.

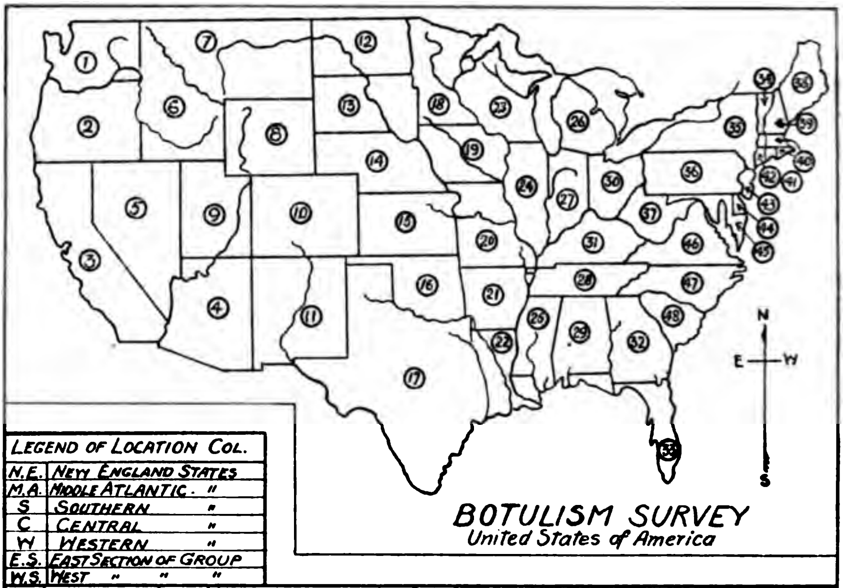
The prevailing view that the poisonous meat must always be "tainted" is not supported by the facts stated in report 70. The ham which caused seven cases had a good appearance and no bad odor.

GEOGRAPHICAL DISTRIBUTION.

A study of figure 8 reveals the following distribution of human botulism in the United States:

	Commercially canned.	Locally grown and home canned.	Unknown.
Arizona	1	0	0
California	12	27	6
Colorado	2	1	0
Florida	0	1	0
Idaho	0	1	0
Illinois	1	0	0
Indiana	1	1	0
Iowa	0	1	0
Maine	0	1	0
Massachusetts	0	2	1
Michigan	3	0	0
Montana	1	0	0
New Jersey	0	1	0
New York	1	3	1
Ohio	1	0	0
Oregon	0	3	0
Pennsylvania	1	1	0
Tennessee	1	0	0
Washington	1	9	1
Wisconsin	1	0	0
Dominion of Canada	1	0	0
Total	29	52	9

It has been pointed out in the introduction that the extensive survey work of the commission is responsible for the data collected in California, which may explain the large number of observations assigned to this State. However, it has been proven that certain States may show an equal frequency of botulism cases provided an effort is made to investigate the distribution more carefully than has generally been the case. In another paper opportunity will be afforded



LEGEND OF LOCATION COL.	
N.E.	NEW ENGLAND STATES
M.A.	MIDDLE ATLANTIC "
S	SOUTHERN "
C	CENTRAL "
W	WESTERN "
E.S.	EAST SECTION OF GROUP
W.S.	WEST " " "

	NAME		OUTBREAKS						NAME		OUTBREAKS				
1	WASHINGTON	W.	11	MANY	11	1	80%	25	MISSISSIPPI	S.E.S.				3	INCOMPLETE
2	OREGON	W.	3	"	7		31%	26	MICHIGAN	C.E.S.	3	MANY		1	"
3	CALIFORNIA	W.	45	185	63	19	29%	27	INDIANA	C.E.S.	2	1	1	1	"
4	ARIZONA	W.	1	MANY		1	25%	28	TENNESSEE	S.E.S.	1	MANY			"
5	NEVADA	W.		"			10%	29	ALABAMA	S.E.S.		"		1	"
6	IDAHO	W.	1		1		INCOMPLETE	30	OHIO	C.E.S.	1				15%
7	MONTANA	W.	1	17		1	"	31	KENTUCKY	C.E.S.					
8	WYOMING	W.		MANY			15%	32	GEORGIA	S.E.S.					
9	UTAH	W.		"			25%	33	FLORIDA	S.E.S.	1	MANY	1	1	INCOMPLETE
10	COLORADO	W.	3	"	3	2	33%	34	VERMONT	N.E.					
11	NEW MEXICO	W.					25%	35	NEW YORK	M.A.	4	3	3	1	43%
12	N. DAKOTA	C.W.S.						36	PENNSYLVANIA	M.A.	2	MANY	1	1	14%
13	S. DAKOTA	C.W.S.					8.4%	37	W. VIRGINIA	M.A.		"			INCOMPLETE
14	NEBRASKA	C.W.S.					20%	38	MAINE	N.E.	1		1		"
15	KANSAS	C.W.S.		MANY			10%	39	N. HAMPSHIRE	N.E.					
16	OKLAHOMA	S.W.S.		"			17%	40	MASSACHUSETTS	N.E.	3	2	2		23%
17	TEXAS	S.W.S.		"			5%	41	RHODE ISLAND	N.E.					
18	MINNESOTA	C.W.S.		"			28%	42	CONNECTICUT	N.E.					
19	IOWA	C.W.S.						43	NEW JERSEY	M.A.	1	MANY	1		31%
20	MISSOURI	C.W.S.		MANY			46%	44	DELAWARE	M.A.					
21	ARKANSAS	S.W.S.		"			19%	45	MARYLAND	M.A.		2	2		54%
22	LOUISIANA	S.W.S.		"			10%	46	VIRGINIA	M.A.		MANY			INCOMPLETE
23	WISCONSIN	C.E.S.	1	"		1	10%	47	N. CAROLINA	S.E.S.					10%
24	ILLINOIS	C.E.S.	1	"		1	26%	48	S. CAROLINA	S.E.S.					INCOMPLETE
STATE NO.		LOCATION IN COUNTRY	HUMAN	ANIMAL	HOME	COMMERCIAL	SOIL %	STATE NO.		LOCATION IN COUNTRY	HUMAN	ANIMAL	HOME	COMMERCIAL	SOIL %

FIG. 8.

to consider the relationship of human botulism to the distribution of *B. botulinus* spores in the soil of certain States. Studies thus far completed indicate that several areas in the United States may harbor comparatively few spores and consequently botulism is either absent or is introduced with food products from territories in which the organism is common.

PART VI.

BOTULISM IN DOMESTIC ANIMALS.

In 1917 Dickson (11) and Buckley and Shippen (12) in two separate publications called attention to the striking similarity of botulism in man with "limberneck" in chickens and forage poisoning in horses. These papers were soon followed by the reports of Graham and his associates (13) dealing with some forms of intoxication in horses and cattle, which were diagnosed as botulism. Aside from these publications the medical literature records also observations of accidental poisoning in hogs, cats, and dogs accidentally contracted by eating spoiled discarded food which had been responsible for human botulism. A careful review of the various publications justifies the following conclusions: The toxin of *B. botulinus* is frequently responsible for the death of barnyard fowls in rural and urban poultry flocks in North America. On the other hand the etiologic relationship of this toxicogenic bacterium to forage poisoning in horses and cattle is based in the majority of instances on indirect evidence. *B. botulinus* is so widely distributed in nature that the mere isolation of this organism from the suspected feed or intestinal tract or spleen of a dead animal is insufficient to support the diagnosis of botulism.

Inasmuch as botulism in poultry accompanied a number of human outbreaks, the commission has attempted to collect and to analyze the available information. Moreover botulism of domestic animals probably assumes in certain localities an important economic aspect, and a critical summary offers an opportunity to discuss some of the problems in animal pathology which deserve careful experimental investigation.

A. BOTULISM IN BARNYARD FOWLS.

Through the observations of Dickson it has been established that a toxemic syndrome is produced in poultry following the accidental or experimental consumption of spoiled food containing the toxin of *B. botulinus*. The affected chickens, turkeys, or ducks exhibit the following symptoms: The birds are inactive and dull, refuse to eat, remain quiet in one place with the feathers ruffled. As a rule the movements of the nictitating membrane are sluggish and sometimes there is a marked constipation, but the general picture of extreme weakness governs all the symptoms; the wings droop and the beak or side of the head rests upon the floor of the cage or barnyard. This latter striking feature of the disease is popularly known as "limberneck." During this stage of the malady the chickens are still able to lay eggs. The clinical manifestations are exceedingly characteristic and easily diagnosed. Although it is sometimes impossible to determine with absolute certainty the cause of sporadic limberneck, the field observations to be presented definitely show that botulism in fowls differs clinically and etiologically from "leg weakness" and "wry neck," two dietary deficiency diseases commonly observed in poultry yards.

In order to avoid further confusion this intoxication of barnyard birds should be frankly designated as botulism instead of limberneck. Until epidemiological and bacteriological studies have proven the contention of Graham and Schwarze (14) to be correct, the prefix "avian or type A" botulism appears unnecessary, misleading, and should be discontinued.

The experiments of Wilkins and Dutcher (15) indicate that limberneck is a symptom rather than a disease resulting from the partial or complete loss of control of the muscles of the neck and probably follows not infrequently the ingestion of the larvæ of *Lucilia caesar.* Several years ago Saunders (16) concluded from an elaborate series of tests that the larvæ of the green flies (*Lucilia caesar*) after being contaminated from carrion flesh play an important rôle in the development of limberneck in poultry. The nature of the poison present in the fly larvæ has not been determined. Some of the statements by Saunders and some experiments on guinea pigs reported by Wilkins and Dutcher suggest that the larvæ may contain the toxin of *B. botulinus*, which originated in the carrion.

Number of outbreaks and mortality rate.—The reports dealing with outbreaks of botulism in poultry which have been collected and investigated by the commission are summarized in Table 12; a number of observations are reported for the first time.

TABLE 12.

No.	Food responsible.	Species of bird and number of deaths.	Location.	Date (year and month).	B. botulinus isolated.	Type.	Coincidence with human cases.	Remarks and recorded by—
1	Home-canned string beans	Chickens	San Jose, Calif.	1910				E. C. Dickson.
2	do	25 chickens, 1 turkey	Madera, Calif.	1915				Do.
3	do	130 chickens, 30 turkeys	Santa Ysabel, Calif.	1915				Do.
4	do	80 chickens, 6 turkeys	Escondido, Calif.	1915				Do.
5	do	25 chickens	do	1915				Do.
6	do	8 chickens	San Jose, Calif.	1916, Jan.	Crop and gizzard of 3 chickens; 6 examined.	A	1 case	Do.
7	do	25 chickens	San Pasquale, Calif.	1916, July			do	Do.
8	do	52 chickens	Berkeley, Calif.	1917				Do.
9	do	12 chickens	do	1918, Feb.	3 jars of beans and gizzards of 2 chickens.	B		Do.
10	do	72 of 81 chickens	Raymond, Calif.	1918, Jan.				Do.
11	do	25 chickens	Sacramento, Calif.	1918, June	Jar of beans and crop of chicken	B		G. S. Burke.
12	do	15 chickens	Santa Maria, Calif.	1918, Oct.	Jar of beans	A		E. C. Dickson.
13	do	Several	Sacramento, Calif.	1919				Commission.
14	do	do	Los Angeles, Calif.	1919, Feb.				Do.
15	do	25 chickens	Oroville, Calif.	1919, Mar.				Do.
16	do	634 chickens	Saratoga, Calif.	1920, Jan.	Cæca and colon of 1 chicken; A toxin in crop.	A		Commission and Dr. Hart, University of California.
17	do	23 chickens	Los Angeles, Calif.	1920, July	Intestinal contents and wall	A		2 jars cold pack; second jar leaking positive in 3 days.
18	do	2 chickens	do	1920, Apr.			1 case	Commission.
19	do	25 chickens	do	1920, Apr.	Crop, gizzard, and intestines of chicken; no toxin in crop.	A		Los Angeles Health Department (Mr. Miller).
20	do	30 chickens	Newmann, Calif.	1920, Aug.				Commission.
21	do	4 of 10 chickens; ducks not affected.	Los Angeles, Calif.	1921, Jan.				Do.
22	do	22 chickens	Mayfield, Calif.	1921				Do.
23	do	25 chickens	Lyons, Colo.	1920, Nov.	Dried crop contents cultured gave a weak toxin; enriched type A.			Doctor Newsom, Fort Collins.
24	do	Several	Decatur, Ind.	1918, Feb.	Jar of beans	B?	7 cases	McCaskey, Amer. Journ. Med. Sci., 1919, *158*, 57.
25	do	do	Klamath Falls, Oreg.	1918, Oct.				E. C. Dickson.
26	do	30 chickens	do	1920, Feb.	Chicken crop and gizzard; A toxin in crop.	A		Commission.
27	do	Several	Newark, N. J.	1918			3 cases	Investigated by de Bord, Journ. Amer. Med. Assn., 1919, *73*, 912.
28	do	24 chickens	Reno, Nev.	1920, Jan.				Commission.
29	do	39 chickens	Ontario, Oreg.	1917, Dec.			1 case	E. C. Dickson.

30	do.	20 chickens	Yelm, Wash	1921, Feb.	Jar of beans	A	do.	Commission.
31	Home-canned corn	25 to 30 chickens	Corning, Calif	1917, Jan.			do.	Do.
32	do.	25 chickens	Hanford, Calif	1917				E. C. Dickson.
33	do.	58 of 66 chickens	San Jacinto, Calif	1917, July				Do.
34	do.	25 chickens	Visalia, Calif	1917				Commission.
35	do.	35 chickens	Calistoga, Calif	1918, Jan.				Do.
36	Commercially canned corn.	10 chickens experimentally	San Rafael, Calif	1918, May	Crops and gizzards of 2 chickens; negative.		1 case	Experimentally produced by health officer, Journ. Amer. Med. Assn., 1919, 74, 1079.
37	Home-canned corn	25 chickens	Santa Rosa, Calif	1919, Oct.				Commission.
38	do.	50 chickens	Escondido, Calif	1920, Apr.				Do.
39	do.	35 chickens	Biggs, Calif	1920, Aug.	Chicken gizzard 6 weeks in soil	A	1 case	Do.
40	Spoiled, moldy corn	30 chickens	Los Angeles, Calif	1921, Jan.				Dr. Carr, Los Angeles.
41	Home-canned corn	25 chickens	Fort Collins, Colo	1920	Dried crop contents cultured gave weak toxin.			Dr. Newsom, Fort Collins.
42	do.	Several	Washington, D. C.	1920, Oct.	Crop of chicken	B		Report of Bureau of Animal Industry, Oct. 13, 1920.
43	do.	50 chickens	Hillsboro, Oreg	1915, Oct.	Contents of gizzard of chicken advanced decomposition.	A	1 case	E. C. Dickson.
44	do.	30 chickens	Yakima, Wash	1916, Jan.			do.	Commission.
45	do.	50 chickens	do.	1916, June				Do.
46	do.	25 chickens	do.	1917, Nov.			1 case	Do.
47	do.	30 chickens	do.	1918, Dec.			do.	Do.
48	do.	25 chickens	do.	1919, June				Do.
49	do.	30 chickens	do.	1920, July				2 horses; commission.
50	do.	50 chickens	do.	1920, Dec.	Jar of corn	A	1 case	Commission.
51	do.	25 to 50 chickens	do.	1921, Apr.	B. toxin crop; B. botulinus not isolated.	B		Commission; chicken buried 2 weeks.
52	Home-canned asparagus	30 chickens	Oroville, Calif	1919, Mar.				Commission.
53	do.	50 chickens	Menlo Park, Calif	1920, Aug.	Decomposed chicken crop; no toxin in crop.	A		Do.
54	do.	30 chickens	San Jose, Calif	1920, Nov.				Do.
55	do.	Several	Seattle, Wash	1917	Contents of crops and gizzards of 7 chickens; 10 examined.	A	1 case	E. C. Dickson.
56	do.	12 chickens	Yakima, Wash	1910			1 case	Commission.
57	Home-canned apricots	Several	Fallbrook, Calif	1915, Mar.			5 cases	1 dog; E. C. Dickson.
58	do.	25 chickens, 1 turkey	Madera, Calif	1918, Jan.	Gizzard of 1 chicken	A	8 cases	E. C. Dickson.
59	Bean hay	150 chickens	Burbank, Calif	1918, May				Dr. Hurt, Los Angeles.
60	do.	40 to 50 chickens	Colusa, Calif	1920, Mar.	Bean plant	A		Also horses; commission.
61	Home-canned peas	50 chickens	Yakima, Wash	1920, June				Commission.
62	do.	30 chickens	do.	1921, Jan.				Do.
63	do.	25 chickens	El Cerrito, Wash	1921, July				Do.
64	Home-canned spinach	15 chickens	Toppenish, Wash	1921, Apr.			2 cases	Do.
65	do.	10 chickens	McKenna, Wash	1919, May			3 cases	Do.
66	do.	Several	Battle Creek, Mich	1921, Jan.				Reported to commission by Geagley, Mich.
67	Home-canned tomatoes	26 chickens	Los Angeles, Calif	1920, July				Commission.
68	Commercially canned tomato paste.	11 ducks fed (2 dead)	do.	1916, Aug.				Reported by A. Schneider to commission; seized goods.
69	Moldy bread	20 chickens	do.	1920, Nov.				Commission.

No.	Food responsible.	Species of bird and number of deaths.	Location.	Date (year and month).	B. botulinus isolated.	Type.	Coincidence with human cases.	Remarks and recorded by—
70	Rotten potato peelings	10 chickens	Los Angeles, Calif.	1920, Feb.	Crops of chickens negative according to a report from a laboratory.			Commission.
71 86	16 observations due to raw buried potatoes.	About 600 chickens	Yakima, Wash.	1915–1921				Do.
87– 88	2 observations, moldy potatoes.	25 chickens	Reno, Nev.	1920				Do.
89	Spoiled sour milk	20 chickens	do	1921, July.	Crop and gizzard of 1 chicken negative.			Dr. Vawter, Reno, Nev.
90	Commercially canned tuna.	12 chickens	Los Angeles, Calif.	1920, Feb.			1 case	Commission.
91	Home-canned salmon	40 chickens	Redding, Calif.	1920, Nov.				Do.
92	Pickled fish	75 chickens	San Jacinto, Calif.	1921, July.	Crops, gizzards, and intestines of 2 birds; A type toxin in crop of 1 chicken.	A	1 case	California State Board of Health and Bureau of Chemistry, western division.
93	Home-canned chicken	25 chickens	Delhi, Calif.	1921, June.	Jar of chicken	A		Commission.
94	Spoiled canned goods (unknown variety and method).	10 chickens	Reno, Nev.	1920				Do.
95	Garbage	Several	Illinois	1920	Garbage and intestines of chickens.	A		Graham and Schwarz, Journ. Infect. Dis., 1921, 28, 317.
96	Unknown	100 chickens	Hornbrook, Calif.					Commission.
97	do	20 chickens	Los Angeles, Calif.					Do.
98	do	15 chickens	Elk Grove, Calif.					Do.
99	do	20 chickens	Colusa, Calif.					Do.
100	do	15 to 30 chickens	Oakdale, Calif.					Do.
101	(Clams?)	10 chickens	San Jose, Calif.					Do.
102	(Chicken feed?)	35 chickens	Stockton, Calif.					Do.
103	(Chicken feed?)	25 chickens	do					Do.

ADDITIONS SINCE JULY 31, 1921.

No.	Food responsible.	Species of bird and number of deaths.	Location.	Date (year and month).	B. botulinus isolated.	Type.	Coincidence with human cases.	Remarks and recorded by—
104	Home-canned corn	27 chickens	El Segundo, Calif.	1921, Aug.				Commission.
105	do	9 chickens	Yakima, Wash.	1921, Oct.	Crop of 1 chicken contained type A toxin and B. botulinus isolated.	A	1 case	Health officer; Yakima and commission.
106	Home-canned asparagus	23 chickens	Walla Walla, Wash.	1921, Oct.	3 jars of same pack			Bureau of Chemistry, western division.

In reviewing the data presented in Table 12 certain facts can be determined. Since 1910, 103 reports dealing with botulism in poultry have been collected, although there is no doubt that this figure is incomplete since no search for them has been made in the majority of States of the Union. Moreover it is the belief of the commission that even the data available for the State of California are incomplete because as a rule the occurrence of botulism in poultry yards has been accidentally recorded in the course of an inquiry into an outbreak of human food poisoning. It is not unlikely that only extensive outbreaks attracted attention, while numerous sporadic cases have not been recognized or are only known to a small group of people. The losses sustained by the owners from this intoxication are sometimes considerable and the problem of distribution and frequency of botulism in barnyards unquestionably deserves more attention.

In Table 13, 79 outbreaks of botulism in fowls are arranged according to years. The frequent careless disposal of spoiled home canned food and the recognition of "limberneck" as true botulism probably explain the higher incidence of the last 4 to 5 years.

TABLE 13.—*Annual incidence of botulism in barnyard fowls.*

1910	2	1918	12
1911-13	0	1919	7
1914	1	1920	26
1915	5	1921 (until June 30)	11
1916	5		
1917	8	Total	79

It is usually impossible to determine accurately the number of chickens which died following the eating of toxic food, but in some outbreaks (report 16) the mortality has been very high. The 3,500 chickens, which died from botulism in the 103 outbreaks represent a direct financial loss of approximately $7,000. Considering the indirect losses (value of eggs and carcasses) it will be appreciated that this intoxication has some economic importance, particularly in the Yakima Valley.

Nothing definite is known with regard to the intoxication and mortality rate. As a rule all the birds which consumed the poisonous food showed symptoms and succumbed in from 48 to 96 hours, although death may not occur until after one to three weeks. Occasionally several very large birds showing marked symptoms were seen to recover spontaneously after a prolonged illness of several weeks. Some reports state that only few birds exhibited symptoms or died after eating the food; in these instances the housewives remembered that they had warmed or cooked the spoiled vegetables for a short period before throwing it to the chickens. The mixing of toxin containing spoiled vegetables with garbage may lead to disastrous outbreaks as is well illustrated by report 16 and the recent publication of Hart (18).

The majority of reports mention chickens as the only birds affected. In three outbreaks fatalities among turkeys have been reported, while in one observation (report 21) it is stated that several ducks which consumed the spoiled beans remained perfectly well. According to Dickson (17) and Hart (18) wild birds (wild canary and California linnet) which may have access to the feeding troughs have been seen to develop botulism.

Unfortunately many of the records fail to state the months in which the outbreaks occurred and it is impossible to establish anything definite with regard to the seasonal distribution of the intoxication in poultry. From previous statements, one may assume that most of the outbreaks occur during the winter months when spoiled canned or preserved food is carelessly discarded. This is not entirely the case. At least in California a number of outbreaks was observed during the months of June, July, and August, probably because home-canned vegetables preserved in the early summer undergo fermentation during the hotter months and the housewife immediately discards the spoiled food, occasionally using it as chicken feed.

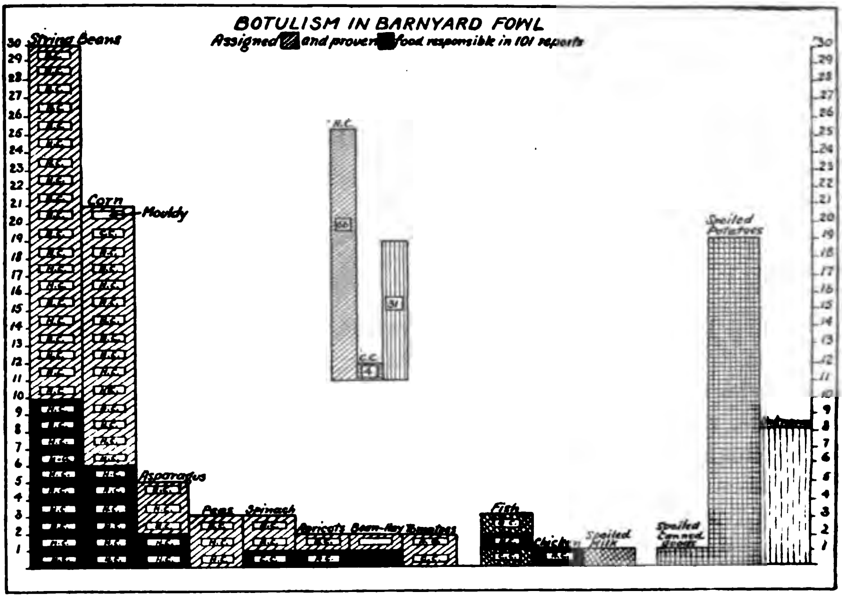


FIG 9.

Foodstuffs responsible.—A casual perusal of the data presented in figure 9 supports again the contention that plant products are the foodstuffs primarily responsible for botulism in chickens, as in man. Aside from the well-known vegetables like string beans, corn, asparagus, spinach, and peas, other plant products are epidemiologically suspected as sources and vehicles for the poison. Numerous observations in Yakima Valley definitely incriminate raw buried or moldy potatoes and potato peelings. It is to be regretted that the diagnosis of botulism thus far depends on a study of symptoms. However it has been possible to demonstrate *B. botulinus* in some samples collected from several potato pits in the vicinity of these outbreaks. Potato poisoning of animals has been attributed to bacterial decomposition with proteus bacilli and in some cases to a poisonous alkaloid, "solanin," said to be present in excessive amounts in diseased and in sprouting potatoes. The latter conception of poisoning due to potatoes is however doubted by the majority of investigators. Similarly inconclusive are the statements that chickens developed botulism following the consumption of moldy bread or bean hay, even though laboratory tests supported the view of the careful observers who reported these cases. Both plant products are suitable for the growth of *B. botulinus* provided sufficient moisture is present. However it is not unlikely that the birds also had access to other spoiled poisonous vegetables. This suspicion has been proven at least in one instance (report 19).

A dead chicken was sent to the laboratory with the statement that a number of the same flock had died with the symptoms of "limberneck." The owner was definite in his statements that the birds were only fed commercial chicken feed. On autopsy, however, a fragment of a string bean was found in the crop and *B. botulinus* was isolated from this specimen. It was never determined where the chickens found the remnants of the toxic food.

In the light of this observation the members of the commission desire to state that they have recorded in Table 12 the causative food products mentioned in the reports submitted by the owner or the veterinarians. There seems to be no doubt that the birds died from limberneck, but it is possible that the causative food had not been determined accurately and that the poison responsible for the intoxication was generated by other bacteria than *B. botulinus*. Invariably an effort has been made to prove the diagnosis by toxicological or bacteriological tests, but in the majority of instances the carcasses had been buried and the demonstration of *B. botulinus* in the decomposed cadavers was of doubtful value.

One-half of the botulism outbreaks in chickens were presumably caused by home-canned string beans and corn. Experimentally 10 chickens were poisoned by commercially canned corn. In a few instances home-canned asparagus, peas, apricots, and spinach were considered the toxin-carrying food. It is noteworthy that spoiled tomatoes, even in one instance commercially canned tomato paste, produced botulism in chickens. According to report 68, 11 ducks were fed experimentally with tomato paste (8 cc. each); all developed clinical botulism and two succumbed. Furthermore, the observations presented in reports 90 and 93 definitely suggest the possibility that both home-canned salmon or fried chicken may undergo spoilage due to *B. botulinus.* The presence of the bacillus in the spoiled chicken was demonstrated by bacteriologic tests. Spoiled sour milk is unquestionably an excellent medium for *B. botulinus* and it is surprising that only one single chicken outbreak epidemiologically attributed to it has thus far been recorded. The long list of outbreaks of botulism in barnyard birds mainly caused by home preserved vegetables, fruits, and fish conclusively proves the contention of the commission, that the methods of preservation can not be considered safe. According to the available records the food products were always spoiled, but the physical disintegration was frequently slight and the vegetables were therefore used as chicken feed. Attention has already been called to the difficulty encountered in recognizing spoilage of string beans, and this peculiar behavior explains in part the high percentage of outbreaks definitely attributed to this vegetable. Probably all of these losses could have been avoided had the housewives followed the recommendations repeatedly made that spoiled vegetables or fruits should not be discarded without previous boiling for at least 30 to 45 minutes.

Certain observations dealing with the behavior of the toxin of *B. botulinus* deserve additional consideration, and are therefore described below;

It is stated in report 17 that Mrs. J. W. Bl. canned on July 23, 1920, two gallon jars of string beans by the cold-pack method. One jar was cooked for one hour and served at the noon meal on July 25. On July 26 on account of a leaking rubber ring the contents of the second jar were discarded and thrown in the chicken yard. The whole flock of 23 chickens showed symptoms of botulism on July 27, and all succumbed in from two to five days. *B. botulinus*, type A, was isolated from the intestinal content. This observation definitely indicates that in the course of three warm summer days a strong *B. botulinus* toxin can be elaborated in a jar of home-canned string beans.

In report 23 it is noted that Mrs. C. B. H. found in the cellar a jar of spoiled string beans. The container was placed outdoors and forgotten. On account of the cold weather the contents froze and broke the jar. The débris was thrown into the chicken yard and caused the death of 25 chickens. This observation supports the laboratory studies which have shown that the toxin of *B. botulinus* is not materially altered by freezing.

Bacteriological or toxicological diagnosis.—It is to be regretted that the diagnosis of botulism was only supported by a bacteriological examination in 23 instances. In 8 outbreaks it was possible to test the causative food by toxicological or cultural methods. In six jars of spoiled vegetables the toxin of *B. botulinus*, types A and B, was demonstrated, while in the remaining two instances the organism was isolated with the aid of enrichment cultures.

Cadavers of chickens were examined in 20 outbreaks. In three chickens obtained from 4 different outbreaks (reports 16, 26, 51, and 92) the presence of *B. botulinus* toxin was demonstrated by the inoculation of guinea pigs with filtered saline extracts of the crop content. The toxin type was also established with the same material in three instances (reports 26, 51, and 92). In this connection it should be mentioned that the dead chicken of 1 outbreak (report 26) had been buried for three weeks in frozen soil. The cadaver was still frozen and in an excellent state of preservation when received at the laboratory. The filtered extract of the crop content killed a 250-gram guinea pig within 24 hours. No toxin could be extracted from the crop contents of two partially decomposed carcasses of chickens obtained from the outbreaks mentioned in reports 19 and 53. The isolation of *B. botulinus* from the crop, gizzard, or intestines of dead chickens was successful in 14 instances. It is not unlikely that the failures mentioned in four reports (reports 36, 51, 70, and 89) must be ascribed to the cultural methods employed. However, it is well known, that the isolation of *B. botulinus* can not always be accomplished from all the dead chickens of one and the same outbreak (reports 6 and 55). The following observation is of some interest in this connection: A bird, which died on the sixth day after the consumption of the poisonous food, harbored the spores of *B. botulinus* only in the cæca, while the crop, gizzard, jejunum, colon, spleen, and liver gave negative cultures. Until quite recently the demonstration of *B. botulinus* in the intestinal tract of chickens, even many days after death and in badly decomposed cadavers was considered conclusive evidence to support the clinical diagnosis of botulism. This conception is now believed to be incorrect for the following reasons:

The spores of *B. botulinus* are widely distributed in nature. They are found in the soil, on vegetables, in chicken feed, etc., and they are probably present with other anaërobes during the decomposition of protein material and in carrion. The methods employed to demonstrate the presence of *B. botulinus* are very delicate; a few spores of *B. botulinus* can germinate in the enrichment mediums generally employed and their progenies can elaborate sufficient poison to give a positive toxin test on guinea pigs and mice. Numerous observations to be reported elsewhere suggest that extreme caution should be exercised in the interpretation of positive cultures obtained from tissues or organs of birds or animals that have been exposed to contact with the soil and its products. The finding of *B. botulinus* in garbage or chicken feed lacks etiologic significance, provided the existence of its toxin in the apparently wholesome or obviously spoiled food can not be simultaneously demonstrated. It is, therefore, frankly admitted that the bacteriological findings on chicken cadavers summarized in Table 12 have very little diagnostic value. Future studies should attempt to establish the existence of the specific toxin in the suspected food or in the crop content of the dead birds. How readily any mysterious disease of birds can be diagnosed as botulism is well illustrated by the following observation:

Two wild ducks were received by the laboratory from a town in Missouri. In the accompanying history it was stated that a large number of the flock had died in the course of from one to three weeks. An examination of the badly decomposed carcasses revealed the lesions of coccidiosis; a few oocysts were demonstrated microscopically. The composite sample of the intestines of one bird, however, gave a culture of *B. botulinus*, type B.

Is B. botulinus, type B, responsible for botulism in poultry?—Graham and Schwarze (17) concluded from some laboratory studies, that *B. botulinus*, type A, administered via the digestive tract is fatal to mature chickens, while type B is nontoxic. Reliable investigations have shown, that at least in four outbreaks (reports 9, 11, 42, and 51) *B. botulinus*, type B, was found in the causative food or the crop of the chickens. The presence of a type B toxin in the crop content of one chicken (in report 51) refutes the contentions of Graham and Schwarze that outbreaks of chicken botulism are always due to type A toxin. Hart and Hayes (19), members of the commission, and workers of the Bureau of Animal Industry have repeatedly noted that chickens are very resistant to a type B intoxication via the digestive tract. It is, however, not unlikely that the differences in susceptibility of poultry to the two types of *B. botulinus* is merely a quantitative instead of a qualitative one. It is suspected at least from an epidemiological standpoint that both toxin types can cause fatal intoxications in chickens but future studies should seriously consider the possible occurrence of a mixture of types in the causative food and in the intestinal canal of chickens, which have been buried for several days before being examined. Quantitative toxicological tests with the causative food or the saline extracts of the crop content of birds, which are not decomposed, will alone settle the uncertainty created by the publication of Graham and Schwarze.

Geographical distribution.—The available reports place the outbreaks of botulism in chickens in the following States:

[No systematic studies made outside of California.]

California	56	New Jersey	1
Colorado	2	Nevada	5
District of Columbia	1	Oregon	4
Illinois	1	Washington	31
Indiana	1		——
Michigan	1	Total	103

The food responsible for human botulism caused in 22 instances the same intoxication in barnyard birds and other animals. This connection between human and animal botulism is therefore invaluable from an epidemiological standpoint and has frequently assisted the medical man to diagnose the nature of the food poison.

B. BOTULISM IN HORSES.

In the course of the epidemiological investigations discussed in this report the commission had occasion repeatedly to record and to study outbreaks of so-called "forage poisoning" of horses. Inasmuch as some of the fatalities among equines were due to foodstuffs which contained the toxin of *B. botulinus* it is considered advisable to briefly analyze the available information and to review the present knowledge on forage poisoning.

In 1900, L. Pearson (20) investigated in Pennsylvania an outbreak of poisoning among horses due to eating moldy silage. The disease was confined to seven horses in a stable; five died after two to four days and two recovered. No autopsies were made. Two horses fed experimentally on the same lot of silage also died after showing tremors, paralysis of the pharynx, and general paralysis (paresis ?), but no brain symptoms were noted. Pearson called attention to the errors in diagnosing diseases of this class as cerebrospinal meningitis because there is no evidence of an inflammation in the meninges of the brain or spinal cord. Since the disease resembled closely "sausage poisoning" in man and since it was evident from his observations that the toxic principles resided in the food, he suggested the name "forage poisoning." Unfortunately this term has not been restricted to sickness in animals due to eating decomposed, moldy, or fermented food as ensilage, but certain diseases of horses (enzootic encephalitis or Borna's disease) which are characterized by cerebral instead of peripheral nerve symptoms have also been diagnosed as forage poisoning.

According to the recent studies of Kraus, Kantor, and Quiroga (21) in Argentina one form of encephalitis is probably caused by a specific diplococcus. On the other hand the review of Udall (22) dealing with the extensive outbreaks of "enzootic encephalitis," reported in 1912 from Kansas, Nebraska, and New Jersey fails to mention the finding of diplococci. The anatomical lesions found and described by McCarthy and Ravenel (23) in an outbreak of forage poisoning are again unlike those described for enzootic encephalitis. From the various reports it seems possible that at least three or four specific diseases of horses, which are etiologically different produce symptoms of similar character. In fact equine botulism bears from a differential diagnostic standpoint the same relation to enzootic encephalitis and allied infections of the central nervous system of horses as human botulism bears to "epidemic encephalitis," cerebral lues, etc., in man.

There occurs however, as already stated, a malady in horses in which it has been repeatedly possible to establish an inseparable relationship between the feed containing a poisonous substance and the intoxication following its ingestion. In 1917 Graham and his associates (16) and Buckley and Shippen (15) suggested that in a number of outbreaks the toxin of *B. botulinus* may represent the poisonus substances in the feed. These workers have definitely shown that the symptons and post mortem findings exhibited by some experimentally intoxicated horses and donkeys resemble those generally noted in true forage poisoning, namely stupor, drooping of the head, marked weakness of the legs and muscles in general, incoordination of the movements, staggering gait, paralysis of the pharynx, paretic, oedematous tongue, salivation,[6] subnormal, or normal temperature, normal or rapid pulse, accelerated and shallow respiration, inability to swallow, and obstinate constipation. The following lesions are found at autopsy: General congestion of the abdominal viscera, marked generalized or patchy hyperaemia of the lungs; petechiae on the serous membranes of the heart and injection of the meninges. Microscopic examinations of the nervous tissues have not been reported. Although the practicing veterinarian is frequently not in a position to observe all of the above mentioned symptoms and lesions, it should however be born in mind that they are sufficiently distinct to make a differential diagnosis between an infections disease involving the nervous system and this intoxication due to a poisonous substance in the feed. On epidemiological grounds the action of poisonous plants can usually be excluded.

Since Graham and his associates championed the etiological rôle of *B. botulinus* in forage poisoning there has developed a tendency to diagnose any mysterious disease of horses, cattle or hogs as botulism. This state of affairs is most unfortunate because the experimental evidence thus far produced is inconclusive. The mere demonstrations of *B. botulinus* enrichment cultures from the suspected feed, a procedure which even in the hand of the experienced laboratory worker is not always successful, is seriously invalidated by the recently established and yet unpublished data indicating the ubiquitous distribution of this bacterium in the soil and vegetation of almost every State in the Union. It should also be stated that *B. botulinus* has been isolated from perfectly sound and wholesome horse and cattle feed. Furthermore the toxin has been readily produced by inoculating and incubating at 27° C. numerous aerobic nonsterile hay, straw, and corn infusions with the spores of *B. botulinus*. In order to prove the etiologic significance of *B. botulinus* in forage-poisoning cases, the presence of the toxin in the feed, its resistance to light, desiccation, and heat under the conditions prevailing in nature should be established by well planned experiments. Some observations of Hart and Hayes (22) make it probable however, that only horses can be used for this purpose. Determination of the relative susceptibility of horses to the ingestion of *B. botulinus* toxin compared with that of guinea pigs, rabbits, mice, cattle, etc., are some of the problems which deserve immediate investigation.

---

[6] There is some question as to whether there is true salivation or whether an apparent increase in salivary secretion exists because the animal is unable to swallow.

In applying these critical considerations to the accounts of forage poisoning in horses and mules either published or collected by the commission, it must be concluded that the toxin of *B. botulinus* was probably the cause of equine botulism in the following four instances:

(1) Five burros died after eating the garbage which contained the remnants of commercially canned string beans or spinach which had been responsible for an outbreak of typical botulism in human beings (see report 74) in Colorado. This occurrence was reported by Curfmann in 1917 (24).

(2) Forty heads of mules were being fed ensilage on a farm in Carroll County, Ky. A number of mules became ill, manifesting symptoms of botulism. Two horses which had been injected with antitoxin and fed on the suspected poisonous ensilage remained well, while one control horse showed symptoms of forage poisoning and succumbed. Reported by Graham, Brueckner, and Pontius in July, 1917 (13).

(3) Nine horses and mules were fed corn ensilage at Ottawa, Ill., 1916. Six of the animals died. Two feeding experiments were conducted on 18 horses; 14 animals received prophylactic injections of botulism antitoxin while four horses served as controls. Only the treated animals except one which died from an intercurrent peritonitis survived. Reported by Graham and Brueckner, January, 1919 (13), and Rusk and Grindley, 1918 (25).

(4) Two horses together with 30 chickens consumed the remnants of a jar of spoiled home-canned corn which had been thrown into a yard at Yakima, July, 1920. The animals developed botulism and succumbed. Investigated by the commission.

The above histories indicate that horses, following the ingestion of preserved or fermented foods, which are known to contain the toxin of *B. botulinus*, may develop a symptom complex typical for forage poisoning. Improperly packed silos undergoing abnormal fermentation undoubtedly offer excellent opportunities for the ubiquitous *B. botulinus* to generate its toxin. It appears desirable to demand, that in the future problems of so important a nature be carefully investigated and the factors which influence the development of bacterial toxins in the ensilage be studied experimentally in the States which use the silo extensively. In this connection it can be stated, that moldy silage of an alkaline reaction is probably more suitable for *B. botulinus* than the same food, which had undergone vigorous lactic acid fermentation. Equine botulism due to silage and home canned products can be more readily controlled by methods other than the use of expensive serums.

In addition to the four indirectly proven outbreaks, a large number of instances of forage poisoning in horses due to moldy hay, straw, corn, potatoes, etc., are being considered in California and in several other States as identical with botulism. Inasmuch as the accuracy of the diagnosis was considered exceedingly doubtful in the majority of the cases reported, the commission has made an attempt to collect further data and opinions from authoritative observers, by sending a circular letter regarding forage poisoning to all the State veterinarians in the Union. The replies were mostly noncommittal and inconclusive, but in order to stimulate further research the data are arranged according to States and are presented in subsequent paragraphs.

(1) *Alabama.*—Reports frequent single and group cases in spring and early summer.

(2) *Arizona.*—Many outbreaks; certain weeds (filiria) and grasses are suspected; repeated examination of such material by the laboratory of the commission failed to demonstrate *B. botulinus*.

(3) *Arkansas.*—No report available.

(4) *California.*—The incomplete reports received by the commission for the years 1911–1920, mention 78 outbreaks of forage poisoning with a total mortality of 123 horses. Twenty-three of the outbreaks occurred in the northern, 20 in the central, and 32 in the southern section of the State. In 35 instances the following feeds were suspected:

Moldy hay	20	Moldy beets	1
Moldy corn	4	Alfalfa	1
Moldy barley hay	4	Straw	1
Grain hay spoiled	2		
Moldy potatoes	2	Total	35

In 42 reports no information relative to the feed was given; on some cards filled out by veterinarians it was mentioned that the disease occurred among pasture animals. In this connection the following observations deserve a detailed description.

(*a*) Colusa: March, 1920, a horse which had been fed bean hay and straw exhibited a staggering gait and disturbed vision, nervous, aggressive attitude, muscular weakness, rapid shallow respiration and coma. The temperature was 100° to 101° F. and later 98° F. The horse died on the third day after the onset of the symptoms.

B. botulinus, type A, was isolated from the dry and clean bean plant. The same organism was also found in several soil samples; 40 to 50 chickens eating the same material died with symptoms of botulism. (See chicken botulism report 60.)

(*b*) Whittier: June, 1920, one horse of three kept on the same premises showed difficulties in swallowing, trembling, paralysis of the tongue, symptoms of colic, general muscular weakness and later coma. The autopsy revealed no gross lesions, but an increased amount of cerebro spinal fluid. Cultures from the spleen and liver were negative. A 10-gram and a 5-gram sample of the intestinal content (colon) contained *B. botulinus*, type A. Three other specimens from other sections of the intestinal tract gave negative cultures. A sample of the hay was nontoxic for guinea pigs, but gave a culture of *B. botulinus*, type B. The other two horses received 50 cc. each of *B. botulinus* antitoxin (University of California), types A and B; they later ingested the same hay without developing forage poisoning; unfortunately nonimmunized horses were not available as controls.

(*c*) Santa Maria: February, 1920, the moldy barley hay which is suspected of having caused forage poisoning in one horse contained *B. botulinus*, type B.

(*d*) Fresno County, near Kings River: November, 1920, the bacteriological examination of the organs of a horse, which died with symptoms of forage poisoning following the ingestion of moldy hay (?) gave the following results:

Brain, spleen and scrapings from the small intestines were negative for *B. botulinus*. Two samples of the intestinal wall, cæcum and colon, contained *B. botulinus*, type A, while one sample of the intestinal wall of the rectum, was negative. The soil on which the hay was grown contained the spores of *B. botulinus*, type A. Unfortunately no specimens of the moldy hay were available for feeding experiments.

(*e*) Oakdale: January–February, 1919, mouldy hay from a large stock supposed to have been the cause of forage poisoning in horses contained *B. botulinus*, type A. Reported by G. S. Burke, Jour. Bacteriology, 1919, IV, p. 551.

In several localities forage poisoning in horses antedated the occurrence of human and fowl botulism.

(5) *Colorado.*—An extensive outbreak, which affected 1,800 horses with a mortality of 1,000 during the months of July to September, 1919, was considered forage poisoning; sporadic cases have been numerous.

(6) *Connecticut.*—Numerous forage poisoning outbreaks have been reported, but "hemorrhagic septicemia" is suspected.

(7) *Delaware.*—Forage poisoning has been prevalent for many years; one county lost 100 horses in 1919.

(8) *Florida.*—Many sporadic cases.

(9) *Illinois.*—According to Graham in the Animal Pathology Exchange, July, 1921, the diagnosis of equine botulism was confirmed in two instances by a bacteriological examination; 36 outbreaks in cattle, sheep, swine, and horses have been recognized.

(10) *Indiana.*—No report available.

(11) *Kansas.*—Many single and group cases have been observed aside from the extensive outbreak in 1912. In three outbreaks an unsuccessful attempt was made to isolate *B. botulinus* from the feed, soil, etc. Healthy animals exposed to the same conditions as the diseased ones were immunized with *B. botulinus* antitoxin without effect.

(12) *Kentucky.*—No official reports available; numerous outbreaks are indicated from the publications of Graham.

(13) *Louisiana.*—In certain localities a disease resembling forage poisoning reoccurs annually; prophylactic *B. botulinus* antitoxic serum treatment is said to have produced satisfactory results. Consult also Bull. 106, Agric. Exp. Stat., Baton-Rouge, July, 1908.

(14) *Missouri.*—Reports an "immense" amount of forage poisoning several years ago.

(15) *Minnesota.*—Numerous outbreaks diagnosed as cerebrospinal meningitis, hemorrhagic septicemia, etc.; many cases have been observed, when animals are changed from dry feed to ensilage, particularly corn silage. Some cases developed in pastures subsequent to heavy rains.

(16) *Michigan.*—No official report, but Miss Lowe states in The Canner (1921, *52*, May, p. 31) that cases of forage poisoning from *B. botulinus* have occurred in the State. The toxicogenic bacterium has been recently demonstrated by the laboratory in silage.

(17) *Montana.*—Reports 17 outbreaks involving 1,004 head of cattle and horses and 3,000 sheep.

(18) *New Hampshire.*—Many sporadic cases and a few extensive outbreaks have been reported.

(19) *New Mexico.*—Several outbreaks have been observed.

(20) *New York.*—No report available.

(21) *New Jersey.*—An extensive outbreak occurred in 1912, near Cape May. Several sporadic cases have also been noted in pasture-fed horses. Graham and Schwarze (26) proved one spleen specimen of a horse to be contaminated with a *B. botulinus*, type A; they failed to isolate *B. botulinus* from a sample of hay obtained from one of the suspected pastures. The laboratory of the commission has made the following findings:

Cape May soil: *B. botulinus,* type B.

Soil on meadow, where horses died in 1912, and salt soil mixture: *B. botulinus*, type B.

Soil, Jones farm, southeastern part of New Jersey: *B. botulinus*, type B.

Soil, Westewelt farm, southeasterm part of New Jersey: *B. botulinus*, type B.

Soil, Johnson farm, southeastern part of New Jersey: *B. botulinus*, type B.

(22) *Nevada.*—Reports 29 outbreaks, several extensive, with reoccurrences on the same ranches. One outbreak was caused by "musty rotten" potatoes and one by garbage.

(23) *Oklahoma.*—Reports for 1920 an extensive outbreak in "river bottom lands;" sporadic cases are quite common.

(24) *Oregon.*—Numerous sporadic cases; one of five horses showed typical botulism at Klamath Falls, where several chicken outbreaks have occurred.

(25) *Pennsylvania.*—Reports isolated outbreaks and sporadic cases.

(26) *Texas.*—Forage poisoning prevalent in the Pecos Valley; moldy corn or cane is regarded as the causative food.

(27) *Washington.*—Reports many outbreaks. According to an investigation of the commission the following feeds were considered responsible:

	Instances.
Moldy potatoes	15
Beet ensilage	4
Moldy hay	2
Rotten turnips	3
Corn ensilage	1
Total	25

(28) *Wyoming.*—Reports several sporadic outbreaks prior to 1919.

(29) *Virginia.*—Many outbreaks have been observed; moldy corn is considered as one of the factors in forage poisoning.

The data thus far secured and synthesized at least justify the conclusion, that forage poisoning, probably due to feeds other than preserved or fermented food, is not uncommon among horses of the United States. An approximate loss of 3,000 horses has been estimated for the five Western States, California, Colorado, Oregon, Nevada, and Montana, within the years 1915–1920. In certain localities the disease reoccurs annually and is of considerable economic importance. Moldy and spoiled hay, potatoes, corn, etc., are the feeds generally mentioned as the products carrying the disease producing poison. It is also stated that the rations may appear wholesome and yet be highly poisonous. However, nothing definite as to the nature of the toxic substance could be determined from the circular letter. Some of the observations in California are suggestive and support the laboratory examinations of Graham and his associates. *B. botulinus* has been isolated from the intestinal tract of two horses which died from forage poisoning in two separate outbreaks. On several occasions the same toxin type was demonstrated in the feed, but repeated attempts to prove the presence of *B. botulinus* toxin by feeding the saline extract of several pounds of suspected feed to guinea pigs were frankly negative or inconclusive. Graham had similar failures in administering to guinea pigs 1 to 2 cc. of water in which contaminated oats had been immersed. It is, however, mentioned that a horse consuming this water succumbed, showing the symptoms of botulism. These and similar observations suggest that horses may be more susceptible to *B. botulinus* toxin via the digestive tract than guinea pigs. Provided this statement is correct the presence of *B. botulinus* toxin in horse feeds must in the future be demonstrated by ingestion experiments on immunized and nonimmunized horses. It will probably be necessary to employ the same species of animal for subsequent experiments, to establish the influence of desiccation and light on the toxin of *B. botulinus* produced in damp hay or cereals. In fact, the entire toxicological problem must be studied on horses and it would appear economical if a number of States, which suffer from forage poisoning appoint a commission and pool their financial resources for a thorough unbiased study of this malady.

Among the various unknown causes which contribute to the generation of the botulism toxin in spoiled hay and vegetables, moisture and heat are probably the most essential, although sufficient time must elapse since the preceding harvest to permit the formation of the toxin. An inquiry into the seasonal distribution of forage poisoning in California revealed the fact that the disease increases during the fall and winter months. In Figure 10 an attempt has been made to parallel the monthly number of forage poisoning outbreaks with the monthly rainfall recorded for the last six years in the localities in which the disease occurred. During the months of October and November an average temperature of 71° F. prevailed in the southern section while a temperature of 55° F. was noted in the northern section of the State. The climatic conditions in form of early rains followed by warm weather in September and October were excellently suited for the growth of molds and bacteria and probably also *B. botulinus*. It is therefore of interest to note that nearly one-third of the forage poisoning cases were recorded for the months of September, October, and November. In other States the two factors arbitrarily chosen for consideration act at different seasons of the year, a fact which may explain the prevalence of forage poisoning either during the spring and early summer, or fall and early winter. Observations made in New Jersey, however, have shown that forage poisoning disappears after the first heavy frost. Inasmuch as the toxin of *B. botulinus* is resistant to cold and can be preserved in a frozen state for at least three weeks the above mentioned fact rather indicates that this poison is probably not the main cause of forage poisoning in New Jersey irrespective of the bacteriological demonstration of *B. botulinus* in the spleen of a horse by Graham and Schwarze and our own isolation of the bacillus from soil specimens. It is to be regretted that most of the reports received were sketchy in character and did not supply enough data to permit additional conclusions as to the etiological agent of food intoxications in horses.

Early in the course of the studies it was thought that the demonstration of *B. botulinus* in the intestines of horses or in the feed had some diagnostic significance and that it was indicative of equine botulism. Subsequent laboratory tests and in particular the isolation of *B. botulinus* from the tissues of cattle, which died from other diseases than botulism, seriously invalidated the original conclusions. Tests have been undertaken to establish in what proportion *B. botulinus* can be isolated from the viscera of slaughtered animals by the procedures customarily employed in the laboratory. Until these studies are completed or until other experiments have either demonstrated the presence of the preformed botulism toxin in the suspected feed or proven that the bacillus possesses invasive properties for horses, the numerous isolations of the organism from animal tissues or the apparently wholesome food can not be accepted as proof for the conclusion that certain forms of forage poisoning are actually equine botulism.

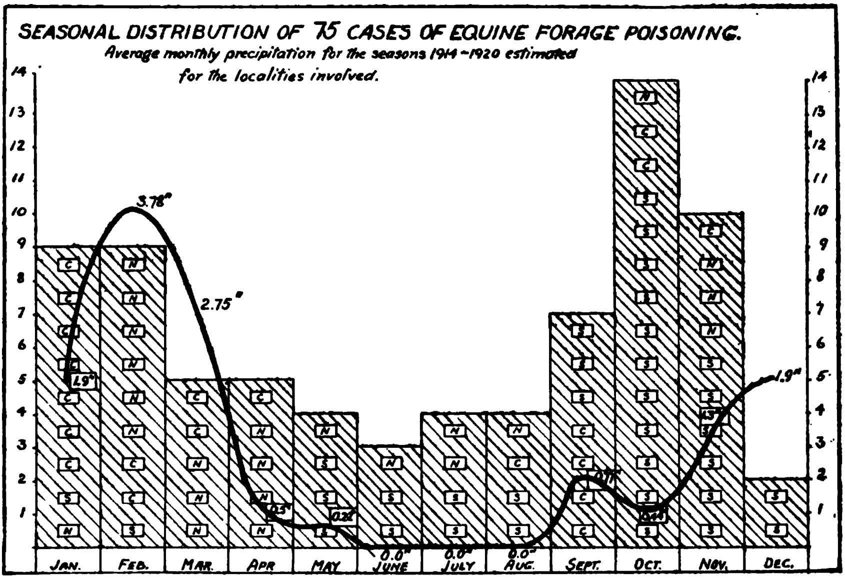


FIG. 10.

C. BOTULISM IN CATTLE.

Hart and Hayes (19) concluded from their experiments that cattle are resistant to *B. botulinus* toxin and probably could consume a very large amount by mouth without effect. Recently Graham and Schwarze (27) reported some observations on a sporadic toxemia in cattle which has some bearing on this subject. Several cattle of a herd consuming corn silage from which *B. botulinus* type B, was isolated, developed symptoms of forage poisoning on two different occasions and four animals died. The two workers concluded that *B. botulinus* toxin in the ensilage was primarily related to the disease in question. A feeding experiment on 43 cattle which had been injected with botulinus antitoxin was inconclusive, one animal, which did not receive antitoxin showed no visible illness. In this connection one recalls also the work of Theiler and his associates (28) on lamziekte, a disease of cattle in South Africa. Deficiency of phosphorous in the vegetation of certain areas during the drought season leads to the development of pica or craving for carrion, which contains a highly potent toxin. The "lamziekte toxin" resembles the toxin of *B. botulinus*, but it is stated that the symptoms of experimental botulism in cattle are distinctly different from lamziekte. Unfortunately the bacterium responsible for the "toxin of lamziekte" has not been isolated in pure culture.

In the light of these reports it is considered important to describe some observations collected by the commission. No attempt had been made to investigate systematically certain maladies of cattle which were suspected by veterinarians as botulism, but the findings to be reported were made accidentally and their bearing on the problem of bovine botulism could not be underestimated.

In 1914, one member of the commission (K. F. M.) (29), investigated in cooperation with the State veterinarian a fatal cattle disease which occurred in the mountainous regions of California and Nevada. The malady was characterized by a hemolytic jaundice, hemoglobinuria and extensive anemic infarcts in the liver. Attention was called at that time to the presence of various types of anaerobic bacteria in the liver lesions. Other work prevented further studies in California, but the late Dr. W. B. Mack and more recently Drs. E. Records and L. R. Vawter, of the University of Nevada, have diligently pursued research work in order to find the cause of the disease and to prevent the extensive losses which have been noted in Nevada. In January, 1921, Dr. L. R. Vawter discussed with members of the commission some of the anaerobes which he had isolated from the liver infarcts. Subsequently a culture of a toxic bacterium was sent to the laboratory of the commission and identified as *B. botulinus*, type A. On January 27, 1921, Doctors Records and Vawter with two members of the commission autopsied, near Reno, Nev., a two-year old heifer four hours after death. The animal showed the typical lesions of the ictero-hemoglobinuria disease. *B. botulinus*, type A, was isolated independently by two different laboratories from the liver lesions, lymphnodes, intestinal wall, and content. Fresh cattle manure and hay obtained from a haystack on the ranch gave cultures of *B. botulinus*. A third strain of *B. botulinus*, type B, was isolated from the tissues of a cow which had died from the same disease on a ranch many miles removed from the other two places where the previous fatalities had occurred.

These interesting observations prompted the commission to communicate with various stock owners of California who had lost cattle from the same disease during the last few years. Thus far no specimens have been submitted for examinations; but in February the laboratory of the Los Angeles Department of Health forwarded a broth culture containing the fragments of a liver infarct which had been removed from the cadaver of cow. This animal which was from a dairy farm near Los Angeles had shown all the symptoms of icterohemoglobinuria. *B. botulinus*, type A, was isolated from the specimen.

These findings of *B. botulinus* were considered very suggestive until Doctor Vawter informed the commission that he has not been able to again isolate the same organism from several cases of icterohemoglobinuria, which came subsequently under his observation. Moreover, Doctors Records and Vawter concluded from their experiments on cattle that in Nevada at least a certain type of *B. welchii* is responsible for the fatal cattle disease. A report dealing with their important observations on experimental botulism and the differences between this toxemia and icterohemoglobinuria has been recently published (Jour. Am. Vet. Assn., 1921, *60*, p. 155.) From the facts just presented it must be concluded that *B. botulinus* is not infrequently a common inhabitant of the intestinal tract of cattle; in the course or during the agonal stage of certain diseases it may even invade the tissues. It is only remotely possible, that these bacteria have an etiological relationship to the lesions from which they have been isolated. In fact it was because of the observations made on these cattle that the statement has been so frequently repeated in preceding chapters that the mere cultural isolation of *B. botulinus* can not be considered diagnostic of botulism.

D. BOTULISM IN HOGS.

Hogs display a marked resistance to poisoning from *B. botulinus* toxin experimentally fed in relatively large doses. In several reports it is mentioned that one or several hogs which consumed a considerable portion of poisonous home-canned food failed to show any symptoms of intoxication, although a number of chickens which ate some of the spoiled food developed fatal botulism. In the course of the investigations conducted by the commission a number of inclusive reports, which attribute several fatalities among hogs to the ingestion of a *B. botulinus* like poison in feeds, garbage, and spoiled home-canned products, have been collected. This information is tabulated in Table 14.

TABLE 14.—*Botulism in hogs.*

No.	Food responsible.	Number of hogs.	Location.	Date (year and month).	B. botulinus isolated.	Type.	Coincident cases.	Reported by—
1	Home-canned string beans	6 sick; no deaths	Yelm, Wash	1921, Feb	Jar of string beans	A	1 human, 20 chickens	Commission.
2	do	1 died	Decatur, Ind	1918, Feb	Jar of string beans and spleen of human case.	B	7 human	Decatur Democrat of Mar. 1, 1918.
3	Home-canned pears	15 died	Oroville, Calif	1917, Sept				Commission.
4	do	2 sick	Hollister, Calif	1918, Feb	Feces of hog 3 months after ingestion of suspected food.	B		E. C. Dickson, Arch. Int. Med., 1918, *22*, p. 494, and G. S. Burke, Journ. Bacteriol., 1919, *4*, p. 549.
REPORTED AS BOTULISM, BUT DIAGNOSIS NOT CONCLUSIVE.								
a	Beet ensilage	30 died	Yakima, Wash	1919, Nov				Commission.
b	Beet ensilage and moldy beets.	8 died of 25 sick	Artesia, Calif	1918, Dec				Do.
c	Commercial food	4 died	Chico, Calif	1920, Sept	B. botulinus demonstrated in feed.			Do.
d	Home-brew liquor	Several	Colusa, Calif	1919, Sept				Commission and F. Kelley in California State Board of Health Bul., 1919, *15*, p. 114.
e	Garbage	20 died	Perryville, Md	1920, June				Commission.
f	do	16 died	Reno, Nev	1920				Do.

In analyzing the data presented in Table 14 it will be noted that in only three instances was the diagnosis of botulism in hogs supported by bacteriological tests. In two outbreaks the animals recovered spontaneously, but *B. botulinus*, type B, was isolated from the manure of two hogs, which had ingested spoiled home-canned peas three months previous to the stool examination. In seven instances the owners or local veterinarians interpreted symptoms and lesions in a number of hogs to be those of porcine botulism and reported the outbreaks to the commission. Unfortunately there was no means of verifying the correctness of the diagnosis, and the facts are mentioned in order to stimulate further investigations. Until careful investigations have determined the relative susceptibility of swine to the toxin of *B. botulinus*, or until the presence of the poison in the suspected hog feed, hog tonic, etc., has been demonstrated experimentally, it must be concluded that botulism in hogs is very rare and that it has thus far only been proven following the ingestion of spoiled home-canned vegetables.

In this connection a recent publication of Graham (30) deserves some comment. In this paper it is reported that *B. botulinus*, type A, has been frequently isolated from certain local (intestinal?) lesions of pigs; these animals exhibited, following the injection of antihog-cholera serum and virus, symptoms of unthriftiness, muscular twitching, posterior paralysis, etc. Inasmuch as 16 per cent of the commercial hog-cholera serum and virus samples contained *B. botulinus*, it is concluded that the swine disease is probably hog cholera superimposed upon a specific intoxication due to *B. botulinus*. It is not stated whether the samples of hog-cholera serum and virus have been tested for the toxin of *B. botulinus* but is assumed that the bacterium possesses invasive properties and is capable of causing a specific low-grade intoxication in hogs. The data presented fail to warrant such far-reaching conclusions; in fact, they only confirm the well-known observation that *B. botulinus* is an inhabitant of the intestinal tract of hogs and that carelessly prepared hog-cholera serums may occasionally become contaminated with this organism.

E. BOTULISM IN DOGS, CATS, AND GOATS.

In report 22 it is stated that one dog which ingested a part of the discarded home-canned apricots responsible for five human cases and several chickens (report 57) exhibited for a few days the symptoms of posterior paresis, but ultimately recovered. The members of the commission have repeatedly observed similar symptoms in dogs experimentally fed or inoculated with type A toxin.

In connection with one chicken outbreak in Los Angeles (report 21, Table 12) it is authoratively stated that a milk goat which consumed about 1 quart of discarded home-canned string beans exhibited the symptoms of botulism. After an incubation time of two to three days the goat refused to eat; the milk secretion dropped to one-third of the usual amount collected; there was marked constipation and general weakness. Complete recovery took place toward the end of the second week, and four weeks later the animal gave birth to two healthy kids. The type of *B. botulinus* could not be determined. Four months after the consumption of the poisonous feed one examination of chicken feces and goat manure was negative for *B. botulinus*. It is not unlikely that the beans contained relatively little toxin. The housewife tasted some pods without consequences; six ducks, which ate a considerable portion of the spoiled food, remained well, and only six of ten chickens developed botulism. It is well known that goats are very susceptible to subcutaneous injections of *B. botulinus* toxin, and that great care must be exercised in the course of immunization.

PART VII.

FEATURES OF BOTULISM.

A. SYMPTOMATOLOGY AND COURSE.

When discussing the time of onset of symptoms of botulinus intoxication in human beings, it must be borne in mind that the victims of botulism fall into two main groups, viz, those in which there is initial acute gastrointestinal disturbance, followed by the typical botulism symptoms, and those in which the typical botulism symptoms are the first to manifest themselves. Approximately one-third of the recorded cases in this country in which data are available have shown symptoms of the acute gastroenteritis type, nausea, vomiting, and diarrhea, which usually come on early, last for from 12 to 36 hours, and disappear with the onset of the typical symptoms of botulism; in the remaining two-thirds of the cases the evidences of nervous system involvement have been the first to appear. The acute gastroenteritis is apparently the result of local irritation by the spoiled food which is ingested, whereas it is now known that the typical botulism symptoms are the result of the action of the botulinus toxin upon certain portions of the peripheral nervous system (31).

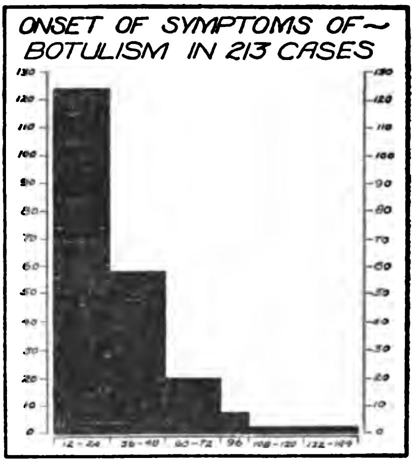


FIG. 11.

The onset of symptoms in botulinus intoxication is usually from 18 to 36 hours after the ingestion of the poison, although they may appear very much earlier or may be considerably delayed. The earliest onset recorded in the American literature is 2 hours (88) and, in this series, 4 hours after (66) the consumption of the spoiled food; and the most delayed onset in this series (54) occurred on the eighth day. In 74 per cent of the cases the onset of symptoms occurred within 48 hours (Figure 11), and in general it may be stated that when the symptoms occurred very early they were of the acute gastrointestinal type.

When gastrointestinal symptoms are present, the patient may complain of burning and distress in the region of the stomach, or there may be nausea and vomiting, with or without diarrhea, which may persist for a few hours or for a day or two. The characteristic effect of botulism is, however, an early inhibition of the gastrointestinal movements, which results in early and persistent constipation, and when initial diarrhoea is lacking the constipation may be one of the first symptoms noted. Frequently there is distention of the intestines, but there is rarely any pain, tenderness, or rigidity after the diarrhea has ceased. The earliest symptom in the majority of cases is a peculiar indefinite lassitude and fatigue, sometimes associated with dizziness or headache, which the patient often attributes to the accompanying constipation.

Disturbances of vision occur very early, and are frequently the first indication of serious illness. There may be initial scintillations and dimness of vision, due to early loss of ability to accommodate for near vision. There is early involvement of the third cranial nerve, and the occurrence of blepharoptosis, mydriasis, loss of reflex to light stimulation, and diploplia is practically constant. Occasionally the pupils may be irregular in contour and unequal. Complete loss of accommodation soon follows. Impaired function of the external rectus muscle appears earlier and more frequently than of the superior oblique muscle. Nystagmus and vertigo are not uncommon, and photophobia has been recorded in a few cases. Nystagmus may be seen on one side only.

The majority of authors agree that there is no disturbance of the retina. Apparently the dimness of vision is dependent upon loss of ability to accommodate, as usually the patient can distinctly see distant objects with either eye alone.

Coincidently with or closely following the onset of visual disturbances there is usually difficulty in swallowing and in talking, and frequently the patients complain of a sensation of constriction of the throat. The tongue appears to be larger than usual, is sluggish in its movements, and heavily coated on the surface although the edges may be clean. There may be complete paralysis of the pharyngeal muscles with loss of the pharyngeal reflex. The voice is low and without normal tone and eventually there is complete aphonia. Even in the milder cases the onset of early fatigue of these muscles is very evident, and after short attempts at conversation speech becomes noticeably slower and more difficult and the voice more husky.

The difficulty in swallowing is apparently largely due to impaired function of the pharyngeal muscles, as the patients state that they have difficulty in forcing the food from the pharynx into the esophagus but that if it is once started they can easily swallow. It is probable, however, that the dryness of the mouth and throat is a contributing factor, as in the milder cases the patients are able to swallow solid food if they take a drink of liquid. Attempts to swallow frequently induce strangling spells which may be very severe, and may persist until the patient is exhausted. Regurgitation of fluids through the nose and insufflation into the trachea and bronchi frequently occur during the strangling spells.

General muscular weakness, especially weakness of the muscles of the neck, is most striking. In severe cases the patients lie with the muscles completely relaxed and are unable to raise their arms or legs from the bed, but although such a condition closely simulates paralysis it is seldom that true paralysis of the skeletal muscles is observed. There is often incoordination of the muscular movements of the arms and legs, and the patients may have difficulty in picking up small objects and may walk with an atoxic gait but the reflexes of the skeletal muscles are practically always intact.

A very striking characteristic of botulinus intoxication is the almost complete absence of sensory disturbances. There may be initial headache and gastric distress but usually the patient does not suffer any pain. Occasionally there is tinnitus and partial deafness, and a few cases have been reported in which there was numbness and tingling of the extremities, but in by far the greater number of reported cases it is noted that there was no disturbance of sensation.

Mentality usually remains clear until within a very short time before death. Restlessness, insomnia and occasionally hysterical attacks are noted, particularly at the onset, but the patient often becomes apathetic or even somnolent as the intoxication increases. There may be spells of irritability when he is aroused, apparently induced by his inability to make himself understood, or to swallow, and often there is great apprehension of approaching death. Occasionally there may be coma for a short time before death, and a few cases are recorded in which there were convulsions, but a most striking feature of the intoxication is that mentality is usually unimpaired throughout the illness.

Inhibition of many of the secretions is also characteristic and the patients complain bitterly of dryness of mouth, pharynx, and nasal passages. A few cases have been reported in which the salivary flow was increased, and it is said that this is usually true in forage poisoning in horses, but in the cases examined during this investigation the serous portion of the saliva has always been inhibited and there has always been a thick tenacious mucus in the pharynx which is removed with the greatest difficulty.

According to the literature there is usually inhibition of sweat secretion, but it is not uncommon to find the patient bathed in a profuse sweat, which has an offensive odor. When sweating is inhibited the skin becomes hard and dry.

There is considerable variation in the reports concerning the secretion of urine, but apparently in the majority of cases the amount of urine secreted depends directly upon the amount of fluid which the patient has received. Oliguria and anuria have been described, but that is not surprising when one considers the difficulty or impossibility of swallowing liquids. There has been no characteristic change in the urinary constituents or sediment in the cases of this series.

The temperature is usually subnormal. In the majority of cases it ranges between 96° and 98.6° F., and in uncomplicated cases remains low during the whole illness. Not infrequently there may be fever during the last days of the intoxication, but this is usually a sign of the development of broncho-pneumonia.

The pulse rate may be slow in the early stages of the intoxication, but later in the course of the illness becomes rapid. It is not uncommon to observe a rate of from 100 to 120 per minute and in some cases of as much as 150 or 160 per minute. The action of the heart muscle is impaired; there may be no visible cardiac impulse and the heart sounds are feeble and distant. The combination of subnormal temperature and rapid pulse is most striking.

There is often no disturbance of respiration in the early stages of the intoxication, but towards the end breathing becomes difficult and labored, and there may be extreme dyspnoea and irregular breathing, sometimes of the Cheyne-Stokes type, with all the accessory muscles brought into play. Later, as fatigue of the respiratory muscles develops, there may be partial or complete asphyxia and the most frequent immediate cause of death is respiratory failure.

There are very incomplete data concerning the results of the ordinary clinical laboratory tests in botulinus intoxication. As was stated above, examination of the urine shows no characteristic changes from normal. Blood counts have been made in a few cases without revealing any typical blood picture, although the number of cases in which examination has been made is much too small to justify any definite conclusions.

In this series there are records of 8 cases where red blood counts were made and in 7 of them the count was between 5,200,000 and 5,600,000 per c. c. In 15 cases leucocyte counts are recorded and the count varies from 7,000 to 20,400 with 4 below 10,000, 7 between 10,000 and 14,000, and 4, 16,000 or more. In all but two where differential count was recorded the polymorphonuclear neutrophiles were between 70 and 85 per cent. In at least one case where the leucocyte count was over 16,000 necropsy revealed the presence of broncho-pneumonia.

Examination of the cerebrospinal fluid has been recorded in four cases. In one instance it was stated that there were 80 cells per c. c., but the type of cells was not specified. In the remainder the fluid was reported normal.

Blood-pressure records in six cases showed systolic pressures between 120 and 140 mm. and diastolic pressures of from 80 to 90 mm. In another case it was recorded that the blood pressure was normal and in two that the systolic pressure was 120.

The duration of illness in fatal cases varies greatly, although the majority of victims die in from three to six days after ingesting the poisonous food. In a series of 173 fatal cases where data were available, 18 patients died within 48 hours after the food was eaten, and 1 survived for 26 days; but 117 persons, or 67.6 per cent, died in from three to six days after ingesting the poison.

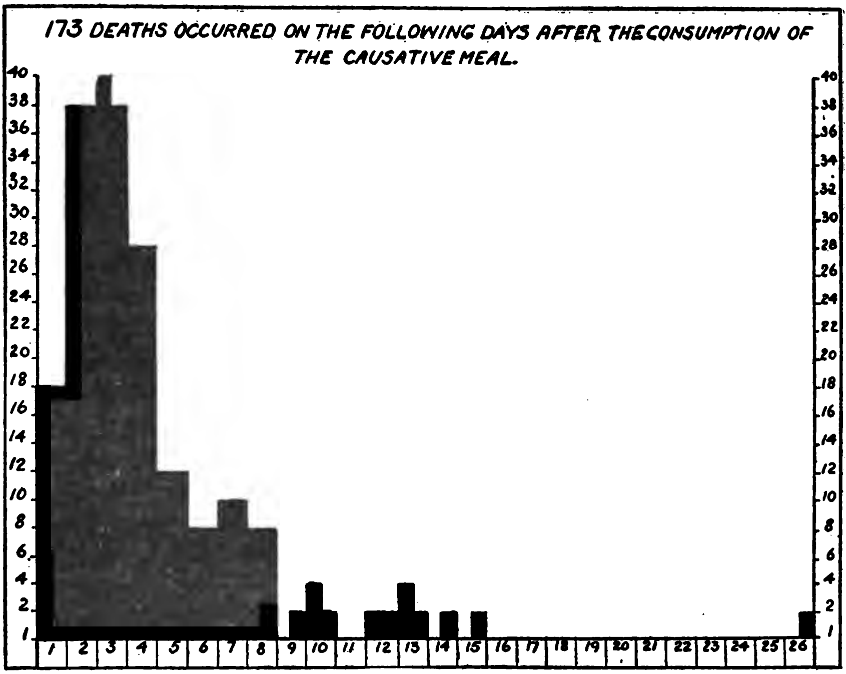


FIG. 12.

Death usually occurs from cardiac or respiratory failure. It has been frequently observed that the heart continued to beat for several hours after voluntary respiration had ceased, and cases are recorded when artificial respiration has maintained life for several hours after voluntary respiration had ceased. Usually there is terminal asphyxia with cyanosis, and occasionally the patient dies in a strangling spell. It is not uncommon that there may be apparent improvement in the general condition of the patient but that death results from insufflation broncho-pneumonia.

When recovery occurs convalescence is extremely slow and tedious. The severity of the illness usually reaches its maximum within 10 days of the poisoning and improvement follows slowly.

The strangling and the difficulty in speaking and swallowing frequently improve first, but the muscular weakness and the disturbances of vision disappear more slowly. Many cases are recorded in which the patients were comparatively well within two or three months, but the weakness, vertigo, and emaciation may persist much longer. The disturbances of vision in some cases are the last to clear up and may persist for months. There appears to be no permanent severe disability, although some patients complain of constipation after recovery has taken place.

B. MORTALITY.

The recorded mortality of botulism in the United States is very high, 61.7 per cent, and is surprisingly uniform in the various areas included under Sections III, IV, and V, viz, California 61.3 per cent, Washington 69.1 per cent, and other portions of the United States and Canada 60.9 per cent. There is very great variation in the mortality of different group outbreaks, however, ranging from zero in report 21, 10.3 and 12.5 per cent in reports 63 and 10, respectively, to 100 per cent in reports 59, 60, and 62, etc.

In a series of 246 cases where data were available and of which 173 resulted fatally, it was found that 147, or 85 per cent, of the fatal cases were persons in whom the onset of symptoms occurred within 48 hours after ingestion of the poison. In many outbreaks there is indication that the time of onset of symptoms is directly dependent upon the amount of poison ingested, and this observation shows that the severity of the illness and the mortality rate is also directly dependent upon the same factor.

A comparison of the mortality among patients who have an initial acute gastrointestinal disturbance before the onset of the typical botulism symptoms, with those in whom the botulism symptoms are the first to be manifested, indicates that, contrary to expectations, the initial vomiting and purging does not materially affect the outcome of the intoxication. All the records of cases in this country do not contain the necessary data, but in 180 cases where data were available it was found that 71.8 per cent of those who suffered acute gastrointestinal disturbances and 73.2 per cent of those in whom there was no initial nausea or vomiting resulted fatally.

C. PATHOLOGY.

There is no characteristic gross lesion by which botulism can be recognized at necropsy. The only constant finding is the marked congestion of the central nervous system and of the abdominal and of thoracic viscera. There may be multiple hemorrhages around the base of the brain and upper part of the cord, and the brain tissues may be edematous and show scattered hemorrhages. The lungs are congested and often show areas of broncho pneumonia. The heart muscle is soft and flabby, the liver, kidney and spleen are hyperemic and all the parenchymatous organs are opaque and cloudy on section. There may be ecchymoses and hemorrhages on the serous surfaces and in the lungs.

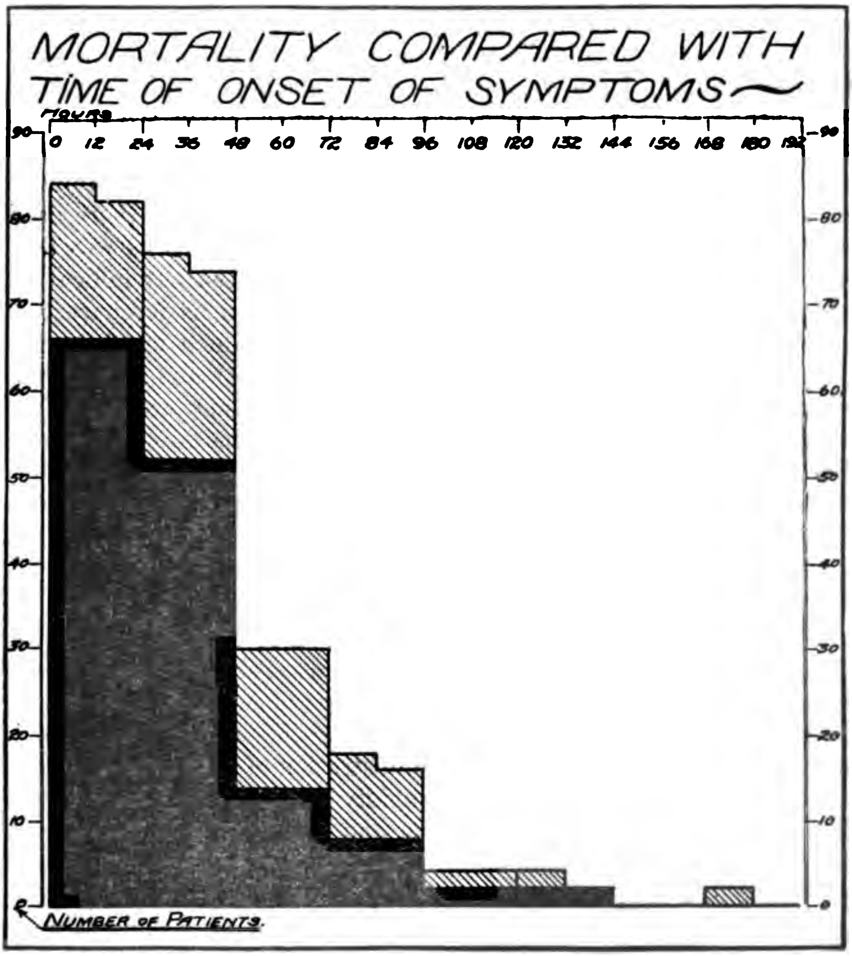


FIG 13.

On microscopic examination, all the tissues show marked congestion, and often the arteries, veins, and capillaries are all engorged with blood. In the brain and meninges there are numerous larger or smaller perivascular hemorrhages around the distended vessels, and in the brain and other organs, especially in the lungs, there may be large hemorrhages which extend beyond the immediate vicinity of the vessel.

The occurrence of cellular thrombi of the type first described by Ophüls (32) are very often found in the tissues of patients in whom the progress of the intoxication has not been too rapid, but they may not occur when the duration of the illness has been very short. When present, they are very suggestive that death has been caused by botulinus intoxication, but, as was recently pointed out by one of us, (Dickson, Journal, A. M. A., 1921, LXXVII, 483), they can not be considered pathognomonic of botulism. In a series of 12 necropsies of human victims of botulism, the tissues of 9 contained the typical thrombi, and of a large series of experimental animals which survived longer than 48 hours after the administration of toxin the tissue of the great majority also contained the thrombi.

In none of this series of human victims of botulism, nor of animals in which the poisoning was experimentally produced, has there been any indication of destruction of the ganglion cells such as was first described by Marinesco (33). Neither has there been any indication of perivascular infiltration with lymphocytes such as is characteristic of epidemic encephalitis, save in one case which has been recorded (Geiger, Public Health Reports, July, 1921) and in which a very few lymphocytes were seen in the areolar tissues around a few of the blood vessels in the brain. There should be no confusion in the microscopic diagnosis between botulism and epidemic encephalitis, since perivascular lymphocytic infiltration is not a characteristic lesion of the former.

D. SERUM THERAPY.

Nothing definite can be said as to the value of antitoxin in the treatment of botulism, although thus far no satisfactory results have been obtained. It has been shown by experiment that animals can be fully protected if sufficient antitoxin is given simultaneously with or within a short time after the administration of the toxin, but that the proportion of the fatalities rapidly increases as the interval between the administration of toxin and antitoxin is increased. A few cases were noted where animals recovered although symptoms of poisoning had appeared before the administration of the antitoxin.

Complete data concerning the administration of botulinus antitoxin to human victims of botulism in the United States are not available, but there are at least eleven outbreaks in which it has been used. In two instances it is known that a type B antitoxin was used in what was later proved to be a type A intoxication, and in three others the details concerning the administration of the antitoxin have not been published. There are six outbreaks, however, in which homologous antitoxin was administered, and concerning which the details of its use are known, and these afford the only reliable data at hand upon which to base any conclusions as to its efficacy.

In these outbreaks (reports 3, 5, 7, 15, 68, and 69) 31 persons were ill and 23 died. Seventeen of the patients died before antitoxin was available and 6 succumbed after receiving the injections. One person recovered without having been given antitoxin and 6 recovered after it had been administered.

The mortality in these outbreaks was 74.2 per cent.

In only three of the outbreaks (reports 3, 5, and 69) did any of the victims recover after receiving the antitoxin, and analyses of these show that in every instance the more severely poisoned persons had died before the antitoxin was administered, and that those who were the more seriously ill when they received the antitoxin succumbed in spite of its use. In no instance was antitoxin available until at least four days after the poisonous food had been eaten, and in one instance it was not administered until the ninth day.

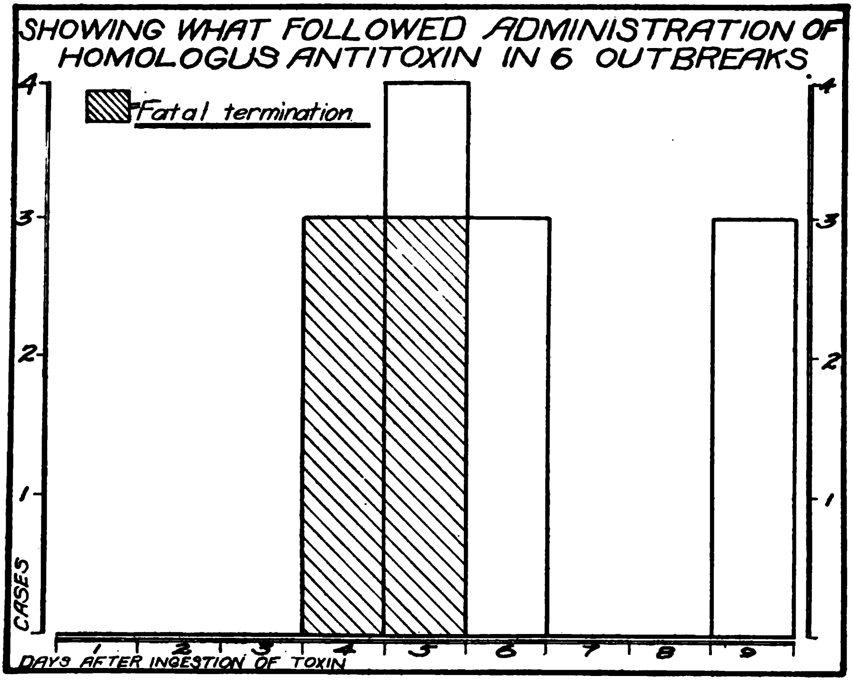


FIG. 14.

The only conclusion that can be drawn from these observations is that botulinus antitoxin is of no value as a therapeutic agent when given late in the intoxication. There has been no record of its administration sufficiently early to enable any comparison with results which can be obtained at will under experimental conditions, and none to indicate that it would not prove efficacious if given early in the intoxication.

In all instances of botulinus intoxication, therefore, the antitoxin should be administered as soon as possible after the consumption of the poisonous food. Time may be gained by using polyvalent serum or a mixture of both types of serum until such time as the type of the toxin has been determined. It should be given intravenously, after the patient has been tested for hypersensitiveness, and, if necessary, desensitized. Large doses, at least 20,000 units, should be given, and since it seems probable that there is no continuous formation of toxin after the poisonous food has been ingested, a single administration of the whole amount of antitoxin is preferable to repeated small doses.

E. BACTERIOLOGICAL DIAGNOSIS.

From the foregoing discussion it is evident that a provisional diagnosis of botulism is often made without difficulties. In fact, the commission has in 61 instances been obliged to recognize the disease by the clinical records of the cases or by the coincident occurrence of botulism in chickens. However, from a medicolegal and also from an epidemiological standpoint, the accuracy of these diagnoses can in some instances be seriously questioned. An attempt should therefore always be made to determine the true nature of the poisoning by bacteriological examinations. Furthermore, in connection with the specific serum treatment, information relative to the type of *B. botulinus* intoxication necessitates the application of laboratory methods. According to a summary presented in Table 15, the following procedures have been employed:

TABLE 15.

No.	Report.	Food and location.	Date.	Toxin in food.	Isolation of B. botulinus.	Type of isolated strain.	Laboratory work conducted by—
1	71	Blood sausage, Massachusetts	1912	Not tested	From sausage		E. M. Randall.
2	73	Cottage cheese, New York	1914	Emulsion 48 hours, incubated at 37°, killed guinea pig within 36 hours.	From cheese	[1] B	Laboratories New York State Department of Health.
3	66	Home-canned corn, Oregon	1915		Gizzard of 1 chicken	A	E. C. Dickson.
4	1	Home-canned beans, California	1916		Crops and gizzards of 3 chickens	A	Do.
5	70	Ham, Florida	1916	Scrapings of ham from around bone produced symptoms in cat and death of 1 dog.	Ham emulsion		E. M. Randall.
6	2	Home-canned string beans, California.	1917		Jar of beans found in cellar, same lot that had caused botulism in 7 persons.		E. C. Dickson.
7	6	Home-canned corn, California	1917		Jar of corn		Bureau of communicable diseases, California State Board of Health.
8	47	Home-canned asparagus, Washington.	1917		Crops and gizzards of 7 chickens	A	E. C. Dickson.
9	15	Home-canned apricots, California	1918		Gizzard of 1 chicken; cultures of spleen and contents of intestine of human case negative.	A	Do.
10	69	Home-canned string beans, Indiana	1918	Liquor surrounding beans nontoxic	Beans and mangoes; spleen of 1 case	B	R. Graham, University of Illinois.
11	67	Home-canned asparagus, Idaho	1919	Not tested	Salad, juice and cap of 1 jar	A	Bureau of Chemistry, U. S. Department of Agriculture.
12	57	Commercially canned olives, Ohio	1919	M. L. D. olive brine=0.001 cc., 0.15 cc by mouth.	Olives and brine; also 5 other jars of 46, same lot.	A	Ohio State University and Bureau of Chemistry.
13	58	Commercially canned olives, Michigan.	1919	0.01 cc., M. L. D	Olives and brine	A	H. W. Emerson, Hygienic Laboratory, University of Michigan, and Bureau of Chemistry.
14	61	Stuffed olives, Montana	1919		Dried pimento stuffing adherent to empty bottle.	A	Bureau of Chemistry.
15	72	Canned sausage, Wisconsin	1919		Sausage meat		F. E. Church, Milwaukee.
16	59	Commercially canned olives, New York.	1920	0.004 cc. by mouth killed mouse in 72 hours.	Olives and brine	A	New York City Board of Health, Department of preventive medicine, Harvard Medical School.
17	7	Minced olives, California	1920	M. L. D. 0.1 cc. of macerated relish	Macerated relish, cultures of contents of colon, ileum, spleen, liver, and lungs of 1 human case negative.	A	Bureau of Chemistry, western division, and commission.
18	60	Commercially canned olives, Tennessee.	1920	0.01 cc. brine caused death of guinea pig in 9 hours.	Olives and brine	A	B. W. Fontaine, Memphis Medical College.
19	68	Commercially canned beets, Arizona.	1920	Washings of dry can nontoxic	Jejunal wall of 1 case on 7th day after eating beets.	B	Commission.

[1] (Nevin strain).

No.	Report.	Food and location.	Date.	Toxin in food.	Isolation of B. botulinus.	Type of isolated strain.	Laboratory work conducted by
20	3	Commercially canned spinach, California.	1920	Food not available	Stool of 1 patient on 6th and 7th days; of another on 12th day after eating spinach.	A	Commission.
21	63	Commercially canned spinach, Michigan.	1921	Fatal to guinea pigs and chickens	Liquor and spinach leaves of numerous cans of same lot; stool of 1 case on 11th day of illness and another on 31st day; negative.	A	R. Graham, Michigan Food and Drug Department, and commission.
22	64	do	1921	do	Liquor and spinach leaves of numerous cans of same lot.	A	Do.
23	65	Commercially canned spinach, Indiana.	1921	do	do		R. Graham, University of Illinois.
24	46	Home canned string beans, Washington.	1921	0.01 cc. of 1:10 saline extract of 1 bean fatal to guinea pig in 28 hours.	From 1 bean	A	Commission and Bureau of Chemistry.
25	50	Home canned corn, Washington	1921		From remainder of another jar of same pack.	A	Commission.
26	62	Commercially canned olives, Pennsylvania.	1921	0.001 cc. brine	Brine and olives	A	Commission and Bureau of Chemistry.
27	4	Commercially canned spinach, California.	1921	Container dry; enrichment gave positive culture.	Washings of can and stool of case on 6th day of disease.	A	Commission.
28	18	Home canned fish	1921	Not available	Crops, gizzards, and intestines of 2 chickens.	A	Do.

(*a*) *Determination of the presence of B. botulinus toxin in the remnants of the causative food.*—In 11 outbreaks (reports 7, 46, 57, 58, 59, 60, 62, 63, 64, 65, 70) the presence of the toxin of *B. botulinus* has been proven by subcutaneous or intraperitoneal inoculations or by feeding of guinea pigs, mice, chickens, cats, and one dog. These tests have been very thorough in the more recent outbreaks caused by ripe olives and spinach; for example, the M. L. D. for guinea pigs of the olive brine has been definitely determined. Such tests should in the future be conducted without delay in order to procure the urgently needed information relative to the average toxicity of spontaneously spoiled vegetables and fruits responsible for human botulism. In several histories it is indicated that a definite relationship exists between the onset and severity of the symptoms, the mortality and the amount of poisonous food consumed.

Aside from establishing the nature of a human intoxication it is of extreme importance that information relative to the type of *B. botulinus* intoxication be made available at the earliest possible moment. The benefits of a therapeutic application of a specific antitoxin depend on an early administration and instead of wasting precious time it is recommended that either a polyvalent serum or an equal amount of both types of antitoxins be inoculated as soon as a proper diagnosis has been made.

The antitoxin prepared against each of the types A and B is specific for the homologous toxin and will not protect against the heterologous one. These type determinations of the poisonous food have thus far been conducted on guinea pigs and mice. Quite recently Graham and Schwarze (34), suggested the feeding of the suspected or responsible food to chickens as a preliminary method of determining the type of *B. botulinus*. They found that type A is fatal when fed to mature chickens, while type B does not produce illness in chickens even when fed in liberal amounts. The commission has had no opportunity to verify this work by feeding spoiled food, which was derived from human or animal outbreaks, but it was pointed out in the chapter on chicken botulism that spontaneous type B intoxication of chickens has been observed.

For a rapid method of determining the types of toxin the methods described by Bengtson (35) and Orr (36) can be recommended if any of the spoiled food is still available. By the inoculation of three series of three mice, each one series with culture, vegetable liquor, fruit juice, etc. (1, 0.5, and 0.1 cc.), alone, one previously inoculated with type A antitoxin and another with type B antitoxin, it may be possible to determine within a short time which type is the causative organism and therefore which type of antitoxin should be used for treatment. Mice are more favorable for carrying out these tests, for the reason that symptoms usually develop more rapidly and more characteristically.

(*b*) *Isolation of B. botulinus from the suspected food.*—In six outbreaks (reports 6, 67, 71, 72, 73) the food which caused the poisoning was either not tested for the toxin of *B. botulinus*, or the liquor surrounding the vegetables was innocuous to guinea pigs (report 69), or the can contained only dry fragments of the suspected material (reports 4, 61, and 68) and in two of these cases (reports 4 and 61) *B. botulinus* was isolated in shake or in enrichment cultures. The types were determined either from the filtered enrichment or from the purified cultures. Methods excellently suited to this purpose have been described in a recent publication (37).

In two outbreaks (reports 2 and 50) the bacteriological diagnosis was made from jars of home-canned vegetables of the same lot that had caused the poisoning.

In seven single of group outbreaks (reports 1, 3, 15, 18, 47, 66, and 68) the remnants of the suspected food were not available and the laboratory resorted to three indirect methods, namely the isolation of *B. botulinus* from the cadavers of poisoned chickens, or the stools of human cases or the intestinal tract or spleen of fatal cases. The first named procedure has already been discussed in the preceding chapter and it was emphasized that in the light of recently acquired knowledge these indirect findings are of limited value. The other two methods deserve, however, some consideration.

(*c*) *The isolation of B. botulinus from the stools of clinical cases.*—Stool specimens of four clinical cases (reports 3, 4, and 63) obtained from three different outbreaks contained *B. botulinus*, type A, on the sixth, seventh, eleventh, and twelfth days, respectively, after the consumption of the causative meal. One specimen each procured from a case on the thirty-first day (report 63) and another from a case on the twenty-sixth day of illness (report 81) were negative. The diagnostic value of the demonstration of *B. botulinus* spores in the fecal remnants of the causative meal, which consisted of spinach in the few positive cases, has been strengthened by additional observations of the commission. Fifty stool specimens of people who had ingested raw vegetables and fruits purchased in the open market proved negative for *B. botulinus*, although repeated examination of the fruits and vegetables these people ate had shown the presence of the spores of *B. botulinus*. Additional tests with several hundred samples from children from rural districts are still in progress of investigation. Inasmuch as constipation is almost a constant manifestation of botulism, it appears quite possible that positive stool cultures may be obtained from convalescent patients for at least two or perhaps three weeks.

On several occasions agglutination tests with the serum of convalescents have been carried out. Various strains belonging serologically to different groups are clumped in dilutions as high as 1:100. Numerous normal human serums gave identical reactions. Thus it would seem that serum agglutination tests can not be used for diagnostic purposes. (See Armstrong, Story, and Scott, Public Health Reports, 1919, *34*, p. 2893.)

Miss Bengtson (35) has suggested the intraperitoneal inoculation of white mice with the citrated blood of persons suffering from botulism as a possibility of establishing a differential diagnosis or to determine the type of intoxication. Kob (38) in 1905 reported that the serum from a patient collected on the ninth day after eating poisonous food caused typical symptoms when injected into white mice, and recently Semerau and Noack (39) in Strassburg demonstrated by the inoculation of guinea pigs the presence of toxin in the serum of four patients on the fourth, sixth, ninth, sixteenth, and even on the twenty-fifth day after the consumption of the poisonous food. In America this procedure has only been tried on one case (report 80) with a negative outcome. These tests are of considerable clinical and scientific importance and should by all means be repeated when the occasion arises.

(*d*) *The isolation of B. botulinus at necropsies.*—Systematic necropsy cultures by means of dependable enrichment mediums have not been carried out. The commission has studied the tissues of four cases (reports 7, 15, 41, and 68) and has isolated *B. botulinus* from the jejunal wall of one case fatal on the fifth day of the disease (report 68) and the brain tissue of another (report 41). The demonstration of a type-B strain in the spleen of one case (report 69) has been reported by Graham. Culturing of tissues like brain, etc., with negative results are mentioned in reports 80 and 81. In this connection it is noted that the paresis of the intestinal tract favors the escape of intestinal organisms into the blood and lymph stream. The report of the bacteriologist and pathologist who made the examination of the brains of two cases involved in outbreaks 63 and 64 describes the presence of *B. welchii* in these tissues. The finding of *B. botulinus* in the spleen of fatal cases must probably also be attributed to either an ante or a post mortem invasion. Members of the commission were not successful in three attempts (reports 7, 15, and 68) to isolate *B. botulinus* from the spleen. In all instances the organs had been removed soon after death.

The demonstration of *B. botulinus* in the stools of clinical cases suggests an examination of the colon and the rectum. In cases which end fatally on the second to fourth days, enrichment cultures, with large samples of the duodenal, jejunal, and ileac chyme or contents, should be carried out. From the standpoint of early diagnosis or in medicolegal cases it is possible that the presence of the ingested toxin might be demonstrated in vomitus or contents of the stomach by the inoculation of laboratory animals with filtrates.

(*e*) *The types of B. botulinus responsible for botulism in the United States.*—In Table 15 the bacteriological findings of the 89 reports are briefly summarized. *B. botulinus* has been isolated from the food or the stools of clinical cases or at necropsy or from the organs of chickens in 28 (31.4 per cent) instances. The toxins or the isolated strains have been typed in 23 outbreaks and 19 cultures have been identified as type A, while only 3 have been proven to be type B. To this list can be added 10 type A and 4 type B isolations from chickens, 6 type A and 4 type B from the feed and the tissues of cases of equine "forage poisoning;" 3 type A and 1 type B, from organs of cattle and one type B from the manure of a recovered hog. Graham (40) states in one of his publications that type B is more frequently encountered in animals than type A. Unfortunately his published records do not contain the necessary data and it has therefore been possible to include in this comparison only the reports of six definitely identified isolations. The relative proportions of the two types isolated from various materials connected with human or animal botulism in the United States is briefly as follows:

B. botulinus, type A	38
B. botulinus, type B	13
Total	51

The significance of these findings is not entirely clear. Both types of *B. botulinus* occur in the soil of the United States; but it has been noted that certain localities particularly the Middle Western and Eastern States furnish more frequently soil cultures which contain a type B toxin. The mutual relationship of the A to the B types is still unknown, but some incomplete observations indicate that *B. botulinus* found in virgin, unfertilized soil is usually type A. However both types have occasionally been isolated from one and the same specimen. The entire problem considering the importance of the various types of *B. botulinus* will be discussed in a paper dealing with the distribution of the spores of this organism in nature.

PART VIII.

GENERAL DISCUSSION.

In the present chapter the data at the disposal of the commission are used for a consideration of three phases of the botulism problem, which are of general interest to the clinician, the packer of food and the epidemiologist. The subjects to be discussed will be treated under the following headings: (1) *B. botulinus* infection versus intoxications due to preformed toxins; (2) The economic importance of spoilage due to *B. botulinus* in home and commercially canned food; and (3) A comparison of the food products responsible for botulism in the United States and Germany.

A. B. BOTULINUS INFECTION VERSUS INTOXICATION DUE TO PREFORMED TOXINS.

The original conception of van Ermengem, who considered *B. botulinus* a toxicogenic saprophyte has recently been questioned by Orr (41) and by Edmondson, Giltner, and Thom (42). These workers found that guinea pigs receiving large numbers of toxin free spores by way of the digestive tract, usually died in from two to four days. Control pigs injected with antitoxin lived. These experiments deserve confirmation; in fact it is by no means proven that large numbers of spores are detoxified by a simple heating to 80° C. for 15 minutes. Laboratory tests have verified the facts established by the above workers, in that guinea pigs developed symptoms of botulism and died after the ingestion of enormous quantities of washed spores, but it was found that in these instances the spores had not been completely detoxified. Further experiments showed that after heavy spore emulsions have been treated with specific antitoxins repeatedly washed and heated at 80° C. in order to destroy the adherent traces of antitoxin they are innocuous to guinea pigs when administered via the digestive tract. Until further experimental studies on other animals are completed it is advisable to scrutinize the various botulism outbreaks for evidence, which would suggest that the spores *B. botulinus* may germinate and produce their toxin in the human body. V. Burke, Elder, and Pischel (43) have carefully analyzed the available information and have come to the conclusion that a true botulism infection following the ingestion of toxin free spores never occurs in human beings. This view is supported by several observations of the commission.

The spores of *B. botulinus* are widely distributed in nature. In certain localities numerous people probably ingest daily spores of *B. botulinus* on raw vegetables and fruits. If the intake of a small number of spores causes an infection, numerous cases of botulism without a history of preserved or canned food having been eaten a short time before the onset of the symptoms, should be on record.

The epidemiologic data of the numerous carefully investigated cases of botulism indicates that the intoxication has always been preceded by the ingestion of toxin-containing preserved food. In four instances, moreover, it is proven that the eating of uncooked spoiled food caused botulism while the ingestion of portions of the same food after cooking provoked no symptoms. These reports deserve detailed description.

Report 17.—A woman tasted a few beans of a jar of home-canned string beans, which exhibited no evident signs of spoilage. She developed fatal botulism. The entire contents of the jar was consumed after boiling for 35 to 50 minutes by three sons without any ill effects.

Report 26.—A mother died of botulism after drinking the fluid from a freshly opened can of home-perserved asparagus. The son escaped illness although he ate a portion of the asparagus after it had been cooked.

Report 47.—A portion of a jar of home-canned asparagus was cooked on Sunday. None of the persons who ate the cooked asparagus suffered any ill effects. On Monday evening the remainder of the asparagus was "warmed up" by placing the jar for a few minutes in warm, not boiling water. The vegetables did not taste good but were eaten by one person, who developed botulism and died on the fifth day.

Report 53.—A housewife tasted sour-tasting home-canned corn; she developed botulism, but recovered. Some of the spoiled-upper part of a jar was thrown out and caused botulism among the barnyard fowls. The remainder of the jar was boiled for 30 to 40 minutes and was consumed by two childrem without any ill effects.

These histories indicate that boiling will as a rule destroy the toxin in the spoiled food, and prevent the development of human botulism. It may also be assumed that the persons, who ate this cooked and spoiled food ingested large numbers of spores without evil consequences. This deduction is, however, not entirely proven. It is known that in a suitable medium comparatively few *B. botulinus* organisms may generate a very potent toxin; in fact the number may be so small that even the usual excellent methods of plating or shake cultures fail to demonstrate the presence of *B. botulinus* (13). Furthermore, it has been repeatedly noted that the heating of spores of *B. botulinus* in fruits or vegetable juices at a temperature of from 80° to 100° C. causes a marked numerical reduction in viable spores. It is therefore quite possible, that the cooking of the spoiled food not only destroyed the poison, but also reduced the viable spores below the number, which as claimed by Orr, and by Edmondson, Giltner, and Thom, is capable of causing a true infection. The experiences gained from the study of past botulism outbreaks, therefore proves that thorough boiling of spoiled food prevents botulism but they do not support or refute the experimental results of the investigators mentioned.

However, in this connection, it should be mentioned that only prolonged boiling until all parts of the food have been maintained at the boiling point for the required length of time (30 to 40 minutes), will detoxify the spoiled food. Numerous epidemiological observations throw considerable doubt on the repeatedly published statements that suspicious canned goods when emptied into a kettle and boiled for five minutes can be eaten without danger. Randall (44) in 1912, had already made the observation that the lethal properties of *B. botulinus* toxin are not impaired by a temperature of 212° F. maintained for 10 minutes. Burke, Elder, and Pischel found spoiled string-bean juice may still be toxic after boiling for 7 minutes, and in order to be safe the spoiled food must be boiled for at least 15 minutes. Laboratory tests conducted by the commission have confirmed these facts, and have shown that the toxin in the vegetable tissues and juices is more resistant to heat than toxin in broth or meat cultures. This difference is probably not entirely explained by the variable heat penetration of vegetables and broth cultures. It is recalled that spoiled string-bean liquor, M. L. D. 0.0001, may remain toxic after 15 minutes boiling in an open kettle.[7] Furthermore, the liquor of a spoiled 2½ can of spinach vigorously boiled for 20 minutes proved fatal to guinea pigs on subcutaneous inoculation, and when fed to the same species of animal caused typical botulism in three days. Depending on the bulk of the spoiled food, size of the kettle and numerous other uncontrollable factors, complete detoxification can usually only be accomplished after boiling for at least 30 to 45 minutes, depending on the altitude. Furthermore, the escape of gas may simulate boiling and may be quite vigorous at temperatures below the boiling point. On account of these uncertainties one is forced to demand with unremitting insistence that food preserved by heat whether home or commercially canned must be processed in such a manner as to ensure either absolute sterility or at least complete destruction of *B. botulinus* in the product, and the thorough boilings of any carrying the slightest suspicion of spoilage.

B. THE ECONOMIC IMPORTANCE OF SPOILAGE DUE TO B. BOTULINUS IN HOME AND COMMERCIALLY CANNED FOOD.

From the numerous sensational statements issued in the daily press, the medical journals and the popular magazines one could conclude that spoilage due to *B. botulinus* is a common every day condition of preserved vegetables and fruits. In fact the impression is being disseminated that certain food products, particularly ripe olives and spinach, are especially liable to be contaminated with the poison, no differentiation being made between home and factory canned food products. Botulism can be prevented, provided the public is fully acquainted with the facts. In this connection it is advisable not only to point out the sources and the character of the danger, but also to restore confidence in the use of canned foods. The data at the disposal of the commission are excellently suited for the purpose, and this chapter is not written to incriminate or to exculpate any particular product, but simply for the purpose of segregating and placing on record all the facts.

---

[7] Recent studies of material obtained from outbreak 90 have shown that the liquor (M. L. D. 0.0001) obtained from a jar of home-canned asparagus was *not detoxified* after being heated in a deKhotinsky bath for *30 minutes at 80°* C. in sealed and open tubes.

It has been previously noted that in 51 instances spoiled home-canned vegetables, fruits, or animal products have been responsible for human botulism in the United States. That the methods which are usually employed in canning vegetables and fruits at home are not always efficient is proven by the frequency with which a larger or smaller proportion of the finished products becomes spoiled. An approximate estimate of spoilage due to *B. botulinus* can be made from the various outbreaks of botulism among barnyard fowls, which developed symptoms of botulism or died following the consumption of poisonous spoiled food. According to Figure 15 there are on record a total of 87 instances in which home-canned spoiled string beans (40), corn (21), asparagus (7), etc., contained *B. botulinus* and its toxin. It is probably impossible to determine accurately the annual amount of home canning done in the United States, and the above figures are therefore only of relative significance.[8] A certain percentage of the home-canned products are discarded by the housewives every year, and it is impossible to estimate how many jars or cans contained the fatal poison. From the facts which can be definitely established at this time, it seems, however, not unlikely that the number of home-preserved products which contained the poison is relatively small. This conclusion is based on certain data collected in California. According to a report of the State home demonstration leader, 1,934 women members in the farm bureaus of 11 counties canned during 1920 the following amount of fruits, vegetables, and meats:[9]

---

[8] It has been estimated by Doctor Farrell of the U. S. Department of Agriculture that in 1917 more than 850,000,000 glass jars of food had been put up at home in addition to all which had been put away in tins. In this connection it is recalled that the yearly commercial pack of fruits and vegetables, exclusive of fish, meats, milk, etc., is approximated at more than 1,099,000,000 cans or containers; in fact, it is known that annually more than 1,000,000,000 cases of commercially preserved food products are placed on the market.

[9] For comparison it is considered advisable to record as far as possible some figures which will give an idea of the extent of the commercial canning carried out in California. According to the report of the Canners' League of California for 1920, the packers preserved the following amounts of vegetables and fruits:

Vegetables:	Cases.	Fruits:	Cases.
Asparagus	1,024,813	Free peaches	1,547,687
Peas	86,074	Cling peaches	5,205,511
Tomatoes	1,858,822	Pears	1,184,288
Tomato products	833,019	Apricots	2,312,000
String beans and other vegetables	481,385	Cherries	647,967

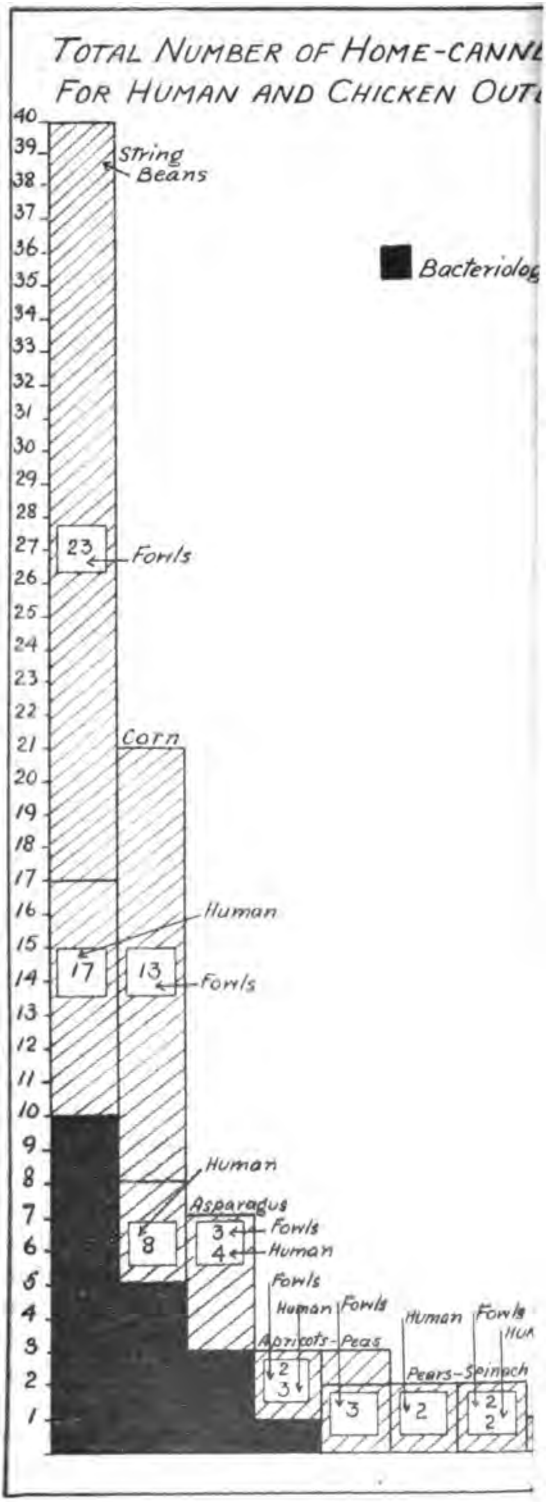


FIG.

4794. (To face page 102.)

Quarts of fruits preserved	19,946
Quarts of vegetables	9,804
Pounds of meat canned	1,136
Pounds of fish	170

During the last 10 years not more than 100 jars have been proven either on epidemiological grounds or by bacteriological methods to contain *B. botulinus* and its toxin. In some of the instances only one jar out of as many as twenty contained the poison. Even if one doubles or quadruples the above figure and for the sake of discussion assumes arbitrarily that per annum an average of 200 quarts of vegetables were toxic, it will be evident that less than 0.02 per cent of the total pack underwent some form of spoilage which was dangerous for human beings. This estimate is probably too high, but the figures indicate that even where *B. botulinus* is widely disseminated in nature and quite frequently present on raw fruits and vegetables and where the problem of botulism has been essentially associated with the consumption of home-canned food, spoilage of vegetables due to this organism is rare.

From the available facts it can be concluded that this form of food poisoning may be prevented by an educational campaign which should emphasize that successful canning of foods in the home depends on cleanliness, soundness of raw material, and thorough processing. There is no doubt that the usual processing temperatures employed in home canning of ordinary vegetables are inadequate. In fact, spores of the recently isolated strains of *B. botulinus* will resist the temperature of boiling water for several hours and, as far as recorded cases go, these spores pass through the ordinary processes of household canning without destruction. In order to avoid spoilage due to *B. botulinus* it is important to recommend only those procedures and methods which take into consideration the heat penetration and acidity of the food to be canned and the spore resistance of the toxicogenic organism. The determination of standardized processes, which will, even in the hands of an inexperienced housewife, preserve a food product from *B. botulinus*, should be practicable, and there is no occasion for discontinuing the preservation of food at home. The method to be used can only be determined by systematic studies of the various physical factors involved in home canning, and by using scientific principles and methods in working out these processes. A revision of the various methods now in use is urgently needed, but it is suggested that new procedures be recommended only after the biology of the spores of *B. botulinus* has been carefully investigated.

Until 1916, only three or four instances of botulism poisoning have been attributed to commercially canned goods, as against a much larger number traced to food prepared in the household, but the tabulated records in Figure 16 show that *B. botulinus* has exerted its activity in the products of the canning factory. In 31 instances commercially packed or preserved foods are suspected of having contained the toxin of *B. botulinus.* In 14 outbreaks the poisonous character of the factory-canned products was toxicologically and bacteriologically proven, while in 13 instances these foods are under grave suspicion, and in 3 outbreaks the available evidence is inconclusive.

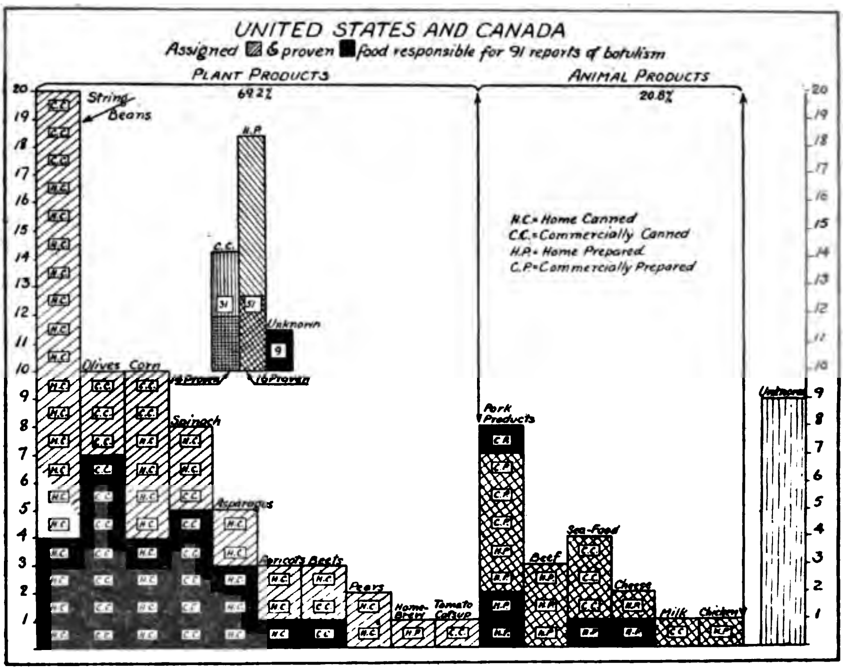


FIG. 16.

Among the commercially canned products which caused 22 of the outbreaks, ripe olives (10) and spinach (6) are mainly mentioned. Certain questions naturally suggest themselves, namely: (1) Is botulism spoilage a frequent or a rare occurrence in factory-canned pickled olives and spinach? (2) Is there any possibility that this form of spoilage may increase in the future? (3) What are the causes and how can *B. botulinus* be eliminated from commercially canned goods?

For more than a generation California has distributed millions of containers of ripe olives and there has never been any indication until 1919 that this food in a preserved state may contain the poison of *B. botulinus.* In the course of the investigation conducted by the Bureau of Chemistry and by other agencies into the causes of this spoilage, it was found that less than a dozen, possibly 9 or 10 containers of ripe olives and 3 cans of minced olives, contained the fatal toxin. In Table 16 the figures dealing with the annual production of ripe olives in California are compared with those of toxin containing jars or containers. It is obvious from this comparison that the actual number of toxic cans is indeed very small and the facts available never supported the sensational statements which had been made in the daily press. The number of cases of botulism poisoning caused by ripe olives and the mortality is no higher than has occurred in many outbreaks from home-canned products. Inadequate sterilization, combined with the practice of holding olives during the war years in water or weak brine solutions, were undoubtedly the causes responsible for *B. botulinus* spoilage. The various agencies which investigated the olive industry agree that efficient sterilization of fresh and carefully handled raw products will prevent further outbreaks of botulism.

TABLE 16.

		Poisonous jars.
1916.	Olive pack consisted of 6,472,000 cans and containers	0
1917.	Olive pack consisted of 5,184,000 as recorded cases go	1
1918.	Olive pack consisted of 6,480,000 as recorded cases go	8
1919.	Olive pack consisted of 7,848,000 as recorded cases go	5
1920.	Olive pack consisted of 3,288,000 processed according to the regulations of the California State Board of Health.	

The six outbreaks due to commercially canned spinach have been traced to four or five different factories. Three outbreaks were caused by cans of spinach which came from two inadequately processed packs of vegetables. It is now known that nearly 70 per cent of the cases of one spinach pack had to be discarded on account of spoilage.[10] Over 45 per cent of the cans examined contained viable bacteria and the liquor of 27 per cent of the swelled cans were toxic for guinea pigs. The actual number of toxin containing containers of spinach is not known, nor is it possible to determine the number of cans which are involved in report 64; hence a comparison similar to that given above for ripe olives would not be supported by facts.

In this connection it must be stated that the yearly average production of canned spinach exceeds 530,000 cases or more than 12,000,000 cans, and if one excludes the two obviously spoiled lots mentioned above one can only conclude that the toxin-containing cans of spinach represent an insignificant part of the total yearly pack. This, however, does not mean that every precaution against its occurrence should not be taken. The studies of various laboratories have thrown some light on the causes responsible for the survival of *B. botulinus* in canned spinach. Underprocessing of poorly blanched leaves in heavily filled containers (97 ounces "put in") must be mentioned as the main factor. Until botulism cases were attributed to canned spinach the packer was mainly concerned in reducing the percentage of spoilage and did not realize that *B. botulinus* must be considered.

---

[10] See p. 42.

This he attempted to accomplish but failed to establish by carefully planned experiments, the process temperatures and the length of time necessary to secure actual sterility of the product. The available evidence indicates that the danger of botulism poisoning due to spinach can be eliminated by processing No. 10 cans, with a fill of 82 ounces and an initial temperature of at least 110° F, at the center of the can, at 252° F. for at least 90 minutes.

In reviewing the various factors which are regarded as conducive to *B. botulinus* spoilage in factory-canned pickled olives and spinach, incomplete sterilization must be considered the most important. Shortly before extensive outbreaks of botulism poisoning due to commercially canned products were reported, Weinzirl (45), and later Cheyney (46) showed that certain classes of canned goods on the market are frequently not sterile and that the proportion of cans containing viable aerobic spores varied according to the product, but might in some products reach as high as 25 per cent. Cheyney says in this connection:

> The more difficult the packers have found it to process a product the more contamination we have found in the cans of that product. This logically leads to the inference that some canned foods at present are being underprocessed and that the usual methods of processing must be increased to obtain actual sterility in these foods.

In the light of these findings it is not surprising that occasionally *B. botulinus* toxin should be found in commercially canned goods. Raw food material contaminated with the spores of *B. botulinus* may be subjected to the ordinary factory processing without the destruction of the spores. The surviving spores may remain latent in the canned food on account of the injury received during processing: they may be unable to germinate on account of the inhibitive action of the fruit and vegetable juices or they may grow and produce a swelling of the cans which causes them to be discarded as not marketable. On the other hand, it is known that canned goods may be nontoxic and yet when carefully cultured show viable spores of *B. botulinus*. These observations may be explained by the fact that certain chemical factors in form of concentration, reaction, and composition of the preserved food exert an inhibitive influence on the spores. In a few cases on record it is proved that they grew and produced a potent toxin with so little visible spoilage that it was unrecognized and was responsible for the poisoning of human beings.

It is unquestionably true that in certain areas agricultural products are more heavily contaminated with the spores of *B. botulinus* than in others, and that botulinus spoilage can therefore not entirely be prevented by careful selection of clean and sound raw material. From a practical standpoint, therefore, it is unfortunately impossible to depend on the action of the inhibitive factors to prevent the formation of toxin when viable spores remain within the container. As a rule the methods are sufficient to ensure freedom from the spores of *B. botulinus*, but the packer should aim wherever possible at absolute sterility of his food products. In this connection it should be noted that the usual understerilization which is met with certain vegetables like corn is mainly due to very resistant thermophiles, which do not grow at ordinary temperatures. From the data presented in previous chapters it is quite evident that the commercial methods have been generally sufficient and that with the exception of pickled olives and spinach understerilization for the spores of *B. botulinus* has been very rare. The danger from this source has now been fully recognized and scientific canning methods are replacing empiricisms. The methods to be chosen for the destruction of the spores of *B. botulinus* are being rapidly developed and it is confidently expected that *B. botulinus* spoilage in commercially canned food will be entirely eliminated in the very near future. The regulations of the California State Board of Health dealing with the packing of pickled olives and the agreement among the California packers of spinach are clearly indicative of the progress which is being made in this direction.

C. A COMPARISON OF THE FOOD PRODUCTS RESPONSIBLE FOR BOTULISM IN THE UNITED STATES AND IN GERMANY.

The recent publication of L. Bitter (47) dealing with botulism in Germany offers an opportunity to compare the causes of the disease as found in the United States with those established for Germany.

It will be noted from Figures 16 and 17 that in America canned vegetables and fruits were primarily involved, while in Germany animal products, particularly pork and fish, carried the fatal poison. Food products which were either preserved by inadequate pickling or by incomplete impregnation with the antiseptic substances of wood smoke or by short boiling and frying caused the majority of botulism poisoning cases in Germany. The only German outbreak which was definitely traced to canned string beans is for various reasons of considerable interest and therefore reviewed in detail.

The Alice Cooking School in Darmstadt preserved some string beans and served a portion in form of a salad at a regular dinner. Fifty-two persons partook of the food; 22 showed severe symptoms of botulism and 11 died. One man who consumed the cooked beans was not ill. The beans exhibited little physical disintegration, but had an abnormal odor. Landmann (48) demonstrated in the remnants of the string beans the toxin and isolated *B. botulinus* in culture. Gaffky (49), who received two empty and one unopened cans of string beans of the same lot, found also an aerobic, butyric acid producing bacterium. The isolated organism resembled *B. botulinus* and produced very potent toxins. The Konserven Zeitung, or trade journal of the packers, expressed in 1904 the opinion that the fatalities which occurred in Darmstadt were caused by bacterial toxins of *B. proteus mirabilis* and *vulgaris*, not those of *B. botulinus*, and it is claimed that several workers were able to support this contention by laboratory tests. In 1910 it was demonstrated by Leuchs (50) that the strains of *B. botulinus* isolated by Gaffky differed immunologically from van Ermengem's original culture. On a comparative basis it appears not unlikely that Gaffky's culture was identical with what is known to-day as a *B. botulinus*, type A, and if so, is probably the only type A culture which has been isolated in Europe. In Germany, botulism is usually caused by food which has not been subjected to severe processing temperatures and, with the exception of the Darmstadt outbreak, the studied cases, as far as they are published, were caused by a homologous group of strains; van Ermengem (51) noted that the spores of his culture were killed by heating to 80° C. for one hour. On the other hand, botulism in America follows the use of canned foods, which as a rule contain type A toxin. The spores of the type A strains resist the temperature of boiling water for a considerable period. Recent studies have shown that the soil of continental countries contains mainly type B strains, while the soil of the American States which had most of

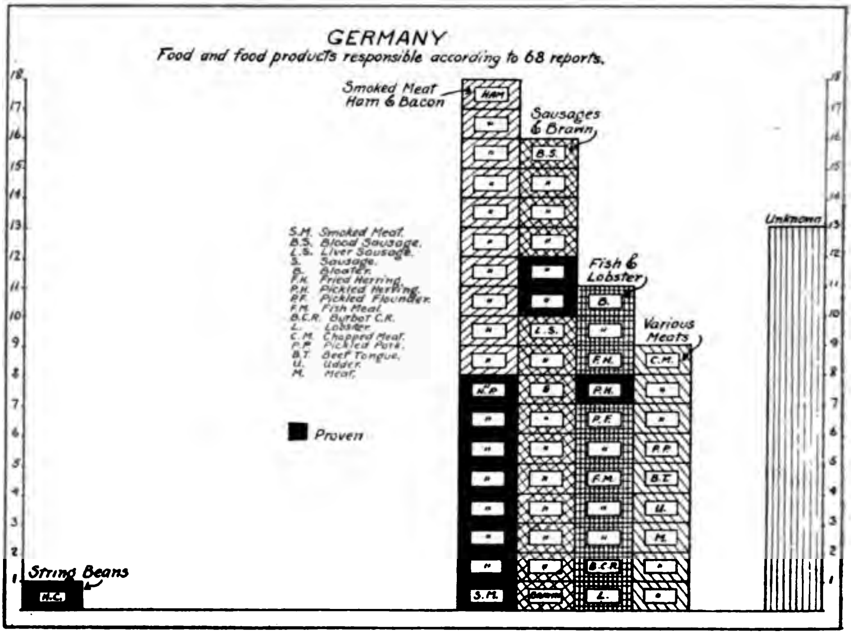


FIG. 17.

the human and animal botulism harbors primarily type A. It therefore seems possible that the absence of botulism in canned food in Europe is either due to higher processing temperatures or to lower heat resistance of the prevailing spores of *B. botulinus*. This suggestion deserves laboratory investigation.

The food and food products responsible for botulism in Germany were primarily home preserved. It is also pointed out that the prevalence of botulism in country districts frequently is due to inadequate preservation on account of the careless and unsanitary treatment to which the raw material is subjected by the rural population. Home slaughtering and preservation of pork products in form of sausages is so universally practiced in Germany that it is not at all surprising to find that about one-half of the botulism outbreaks were caused by this type of food. Inasmuch as many of the German records and histories are rather vague and indefinite, it seems, however, hardly fair to draw further comparative deductions.

PART IX.

CONCLUSIONS.[11]

(1) Outbreaks of botulism in the United States, following the consumption of toxin containing food products are not infrequent, but as a cause of death this intoxication is by no means as important as the numerous publications in the medical journals would imply.

A total of 91 reports dealing with single or group outbreaks of botulism have been collected by the commission. In 30 instances only has the clinical or the post-mortem diagnosis been confirmed by toxicological tests. The following food products have been proven or assigned as the causes for the intoxications:

Home-preserved products.—51 outbreaks; 16 proven.

Home-canned string beans: 17 instances; 4 proven. (Food spoiled and bad odor, 7; bad taste, 4; no signs of spoilage, 3; unknown, 3 outbreaks.)

Home-canned corn: 9 instances; 4 proven. (Spoiled and bad odor, 6; taste, 2; not known, 1 outbreak.)

Home-canned asparagus: 5 instances; 3 proven. (Spoiled and bad odor, 3; taste, 1; no signs of spoilage, 1 outbreak.)

Home-canned apricots: 3 instances; 1 proven. (Spoiled, 1; bad taste, 2.)

Home-canned pears: 2 instances; none proven. (Spoiled, 1; bad taste, 2.)

Home-canned spinach: 2 instances; none proven. (Spoiled, 1; no sign of spoilage, 1.)

Home-canned beets: 1 instance; none proven. (No sign of spoilage.)

Home-brew liquor made from spoiled home-canned fruits and vegetables: 1 instance; not proven.

Cottage cheese: 2 instances; 1 proven. (Putrefactive odor, 1; spoilage unknown, 1.)

Home-pickled mackerel and herring: 1 indirectly proven. (Spoiled.)

Home-cured ham: 2 instances; 1 proven. (Not spoiled, 1; unknown, 1.)

Blood sausage: 1 instance; proven. (Spoilage unknown.)

Salted pork: 1 instance; not proven. (Spoilage unknown.)

Beef products: 3 instances; inconclusive, not proven. (Spoiled, 1; not spoiled, 1; spoilage unknown, 1.)

---

[11] The deduction drawn from reports 90 and 91 are included.

Minced chicken: 1 instance; inconclusive.

Commercially preserved and canned products.—31 outbreaks; 14 proven.

Commercially canned underprocessed spinach: 6 instances; 5 proven. (Visibly spoiled and odor, 2; no signs of spoilage, 4.)

Commercially packed minced olive relish: 3 instances; 1 proven, 2 indirect. (Bad odor, 1; no signs of spoilage, 2.)

Commercially pickled and bottled ripe olives: 7 instances; 6 proven, 1 not proven. (Visible spoilage, 4; bad taste, 1; no signs of spoilage, 1; unknown, 1.)

Commercially canned beets: 2 instances; none proven, 1 indirectly. (Bad taste, 1; no signs of spoilage, 1.)

Commercially canned string beans: 3 instances; none proven, 1 inconclusive. (Spoiled, 1; unknown, 2.)

Commercially canned corn: 1 instance; not proven. (Bad taste.)

Commercially packed tomato catsup: 1 instance; not proven. (Unknown.)

Commercially canned pork and beans: 1 instance; inconclusive. (Spoiled.)

Commercially prepared sausages: 2 instances; inconclusive, not proven. (No sign of spoilage.)

Commercially prepared ham: 1 instance; not proven. (Bad taste.)

Commercially bottled clams: 2 instances; not proven. (Unknown.)

Commercially canned tuna fish: 1 instance; not proven. (Spoiled.)

Evaporated milk: 1 instance; not proven. (Spoiled.)

In recent years a striking increase of botulism has taken place in various localities, and foodstuffs, which were considered safe from *B. botulinus* deterioration have been found to be the cause of this type of poisoning. Laboratory studies have also demonstrated that *B. botulinus* is more widely disseminated in nature than has been generally suspected. Botulism can not be considered primarily a problem of California, the Pacific Coast States or the western slope of the Sierra Nevada and Rocky Mountains. The organized work in California enabled the commission to investigate sources of information, which were not accessible in other States. It is not unlikely that some of the essential findings determined for the Pacific coast could be duplicated by the activities of a similar commission in other localities.

(2) Since 1889 a total of 45 instances of human botulism have been reported for the State of California. A total of 132 people with 81 deaths are involved in these observations.

(3) There is no evidence of any special incidence at any age period. The sex distribution for 115 cases can be summarized in the following formula:

Children: Males: Females: = 1:3.13:3.46.

(4) The intoxication rate is very high; as a rule all who ate the poisonous food became ill. The available data do not permit of a comparison of the infectivity rate of food poisoning with the intoxication rate of botulism. The number of fatal cases varies greatly in different outbreaks. The case mortality rate for 129 cases in California is 61.3 per cent. For the children the mortality rate is higher than in adults.

(5) More than one-half of all the botulism outbreaks of California have occurred during the fall and winter months, namely October to February. In contrast with the bacterial food infections, which are usually prevalent during the hotter months botulism bears no relation to the climate, because it is as a rule intimately connected with the consumption of preserved food, which takes place during the winter season.

(6) Twenty-eight or 62.3 per cent of the outbreaks in California were caused by plant, while 11 or 24.4 per cent were attributed to animal food products; in 6 or 13.3 per cent of the outbreaks the carrier of the toxin was unknown; 13 outbreaks or single cases were caused by home-canned string beans, 2 by commercially packed spinach, 1 by commercially pickled ripe olives, and 3 by commercially prepared minced olive relish, 3 by home-canned apricots, 2 by home-canned pears, 1 by home-canned asparagus, 1 by home-brew liquor, 1 by home-canned and 1 by commercially canned corn, 3 by home-preserved beef products, 1 by commercially preserved and 1 by home-preserved pork products, 2 by commercially bottled clams, 1 by commercially packed pork and beans, 1 by commercially packed tuna fish, 1 by home-pickled mackerel and herring, and 1 by cottage cheese. In 12 instances commercially packed and in 27 observations home-canned products were involved.

(7) The prevalent idea that the food must always be visibly spoiled in order to be toxic is not entirely supported by the available observations, although there is no doubt that five single or group outbreaks were caused by home-canned string beans, which were spoiled by appearance, odor, or taste. The home-canned apricots and pears responsible for outbreaks were either moldy or visibly spoiled and had a sharp bitter taste. In two instances the home-canned corn and asparagus were very distinctly spoiled and emanated an offesive odor. In one report dealing with home-canned corn it is mentioned that the product was not spoiled but tasted "metallic." *It is definitely stated that two jars of home-canned string beans responsible for two outbreaks were not spoiled either by odor or taste.*

Commercially packed spinach was spoiled in one and appeared normal in taste and odor in another outbreak. The commercially canned minced olives connected with two single or group outbreaks were bitter in taste and on standing emanated a definite odor. No signs of spoilage were noted in one can of the same product, although it contained toxin. In the majority of instances the canned food is so spoiled as to attract the attention of the one who opens the container, but it should be emphasized that in four instances (home-canned string beans, commercially packed spinach and minced olives) macroscopic spoilage in form of abnormal consistency or appearance was not visible. *B. botulinus* spoilage can therefore not always be determined by the appearance or odor of the food.

(8) The frequent occurrence of botulism in the southern section of California is closely connected with the distribution of *B. botulinus* spores in nature, particularly in the soil.

(9) An investigation in the State of Washington revealed 13 outbreaks of human botulism (inclusive reports Nos. 90 and 91). A total of 26 people with 18 deaths are involved in these observations. A careful survey in the Yakima Valley demonstrated that there have occurred in this locality during the last five years, 8 outbreaks of human botulism, 27 outbreaks in domestic fowls, 26 in horses, 3 among cattle, and 1 among hogs. The mortality rate among the human cases was 69.1 per cent. Aside from being an important public-health problem, botulism assumes in the Yakima Valley also an economic aspect. Home-canned corn, home-canned asparagus, and home-canned spinach were the foods responsible for botulism. A single case possibly due to commercially canned evaporated milk has been investigated.

(10) Since 1912 a total of 33 instances of human botulism have been reported for the entire United States and Canada, exclusive of the States of California and Washington. A total of 187 people with 114 deaths are involved in these observations. The case mortality rate is 60.9 per cent. Twenty-four or 72.4 per cent of the outbreaks were caused by plant, while 7 or 27.3 per cent were attributed to animal products. In 16 instances commercially preserved foods were involved, namely, pickled ripe olives, 6 (all proven); spinach, 4 (3 proven); string beans, 2 (not proven); beets, 2 (1 proven indirectly); tomato catsup, 1; and sausage, 1 (inconclusive). The following home-preserved foods are mentioned in the reports: String beans, 4 (1 proven); corn, 3 (1 proven); asparagus, 1 (proven); beets, 1 (not proven); cured ham, 3 (1 proven); blood sausage, 1 (proven); cottage cheese, 1 (proven); and minced chicken, 1 (not proven). The commercially preserved foods originated in the following States: California, 9 (pickled ripe olives and spinach); Kansas, 1 (string beans); Ohio, 1 (beets); Wisconsin, 1 (sausages). In the majority of the reports it is stated that the canned food was noticeably spoiled either in appearance or at least in odor. Canned spinach and home or commercially preserved beets may show very little spoilage, although they may contain a very potent toxin. The causative foods were

either improperly preserved or underprocessed (ripe olives and two packs of commercially canned spinach, home-canned string beans, corn, and asparagus).

(11) Botulism is not uncommon among barnyard fowls in urban and rural poultry flocks. One hundred and six observations indicate that spoiled home-canned plant products as string beans, corn, asparagus, peas, spinach, apricots, and fish are primarily responsible for the intoxications. The diagnosis has been supported by bacteriological examinations in 25 instances. In 3 cadavers of chickens obtained from four different outbreaks the presence of *B. botulinus* toxin was demonstrated by the inoculation of guinea pigs with the filtered saline extract of the crop content. *B. botulinus*, type B, was found in four outbreaks either in the causative food or the crop of the chickens.

(12) Certain forms of "forage poisoning" in horses are probably true equine botulism. Preserved spoiled vegetables or ensilage caused four different outbreaks; the presence of *B. botulinus* and its toxin was proven indirectly by immunization experiments or by the coincident occurrence of botulism in human beings or fowls. Until experimental studies have demonstrated the presence of the preformed *B. botulinus* toxin in the suspected feed the numerous isolations of this organism from the cadavers of horses or the suspected wholesome or spoiled feed possess no diagnostic significance for equine botulism. This statement applies in particular to those cases of forage poisoning in which as causative feed, moldy hay, corn, potatoes, etc., are suspected.

(13) *B. botulinus* is in certain localities an inhabitat of the intestinal tract of cattle. In the course or during the agonal stage of some diseases it may invade the tissues. These bacteria have probably no etiological relationship to the lesions or to the diseases from which they have been isolated. The occurrence of spontaneous botulism in cattle has not been proven.

(14) Botulism in hogs, dogs, cats, and goats is very rare and has been noted following the ingestion of poisonous home-canned string beans, peas, and possibly pears.

(15) A typical case of human botulism is usually characterized by delayed onset, with or without initial acute gastro-intestinal disturbance, marked general muscular weakness, disturbances of vision with diplopia and blepharoptosis, dryness of the mouth and pharynx, accumulations of thick mucus in the pharynx, loss of ability to swallow and talk, strangling spells and regurgitation of fluids through nose on attempts to swallow, and persistent constipation. There is rarely any pain or disturbance of sensation. Mentality remains clear. The pulse rate steadily increases as the intoxication progresses, and the temperature is usually subnormal.

Death usually results from respiratory failure but insufflation pneumonia is not an uncommon cause.

(16) The gross appearance of the tissues at necropsy presents nothing that is characteristic. There is marked congestion of all viscera and there may be hemorrhages. Microscopic examination usually reveals cellular thrombi in the blood vessels. Perivascular lymphocytic infiltration is not found.

(17) There are no data to prove or disprove the efficacy of botulinus antitoxin as a prophylactic or therapeutic agent. In all recorded cases when homologus antitoxin has been administered it has been given too late in the course of the intoxication to be of any value.

(18) The diagnosis of botulism was in 11 outbreaks established by the demonstration of the toxin of *B. botulinus* in the remnants of the causative food. These tests have been very thorough in the recent outbreaks caused by ripe olives and spinach. In six instances the food was not tested for toxin, but *B. botulinus* was isolated in shake or enrichment cultures; in three outbreaks the bacteriological diagnosis was made from jars of home-canned vegetables of the same lot that had caused the poisoning.

In eight single or group outbreaks the remnants of the suspected food were not available and the diagnosis was made indirectly, namely, *B. botulinus* was isolated in five instances from the crop or gizzard of poisoned chickens, in two observations from the stools of clinical cases, and in one outbreak from the jejunal walls of a fatal case.

(19) Only 30 outbreaks or 32.9 per cent of the available observations have been proven bacteriologically. *B. botulinus*, type A, has been identified in 21, while type B has been found in 3 outbreaks.

(20) The epidemiologic data indicate that a true botulism infection following the ingestion of toxin free spores never occurs in human beings. In four instances it is proven that the eating of uncooked spoiled food caused botulism while the ingestion of portions of the same food after cooking provoked no symptoms. Canned goods deemed to be abnormal either by appearance of the container or by the odor should be destroyed, not heated and eaten.

(21) Spoilage of home or commercially canned food products due to *B. botulinus* represents an insignificant part of the yearly pack. It is the result of inadequate sterilization. The usual methods of processing must be systematically studied and the packer should aim at absolute sterility of the food products wherever it is possible.

Spoilage due to *B. botulinus* has been limited to a few definite varieties of plant products as home-canned string beans, corn, asparagus, spinach, also home-canned beets, apricots, and pears, and commercially pickled ripe olives, commercially packed spinach, string beans, and beets and corn. *B. botulinus* spoilage in ordinary commercially packed fruits and such vegetables as tomatoes has not been mentioned in the reports. Furthermore many vegetables such as corn and peas require such heavy processes to destroy the nontoxic thermophilic spoilage organisms found in them that the occurrence of botulism from them is very improbable.

(22) In the United States preserved plant products are primarily involved in botulism outbreaks while in Germany pork and fish products contain the fatal poison. In both countries botulism is caused by the use of preserved foods which are not thoroughly cooked before they are eaten.

PART X.

SUMMARY.

Since 1899 a total of 91 single or group outbreaks of botulism have been reported in the United States and Canada. A total of 345 people with 213 deaths or a case mortality rate of 61.7 per cent has been recorded. Only 30 outbreaks or 32.9 per cent of the available observations have been proven bacteriologically or toxicologically. The causative food consisted in 63 outbreaks (69 per cent, 25 proven, 38 not proven or inconclusive) of home or commercially canned plant products, while animal products have been found responsible for 19 (20.9 per cent, 5 proven and 14 not proven or inconclusive) single or group intoxications.

The following food products have been proven or assigned for the various cases of botulism: Home-canned string beans (17), home-canned corn (9), home-canned asparagus (5), home-canned apricots (3), home-canned pears (2), home-canned spinach (2), home-canned beets (1), home-brew liquor prepared from old home-canned products (1), home-prepared cottage cheese (2), home-preserved pickled mackerel and herring (1), home-cured ham (2), home-prepared blood sausage (1), home-cured salted pork (?), and home-prepared beef products (3); commercially packed spinach (6), commercially canned minced olive relish (3), commercially pickled and bottled ripe olives (7), commercially packed beets (2), commercially canned string beans (3), commercially canned corn (1), commercially canned pork and beans (1), commercially bottled tomato catsup (1), commercially prepared sausages (2), commercially cured ham (1), commercially bottled clam juice (2), commercially canned tuna fish (1), commercially canned evaporated milk (1), and commercially prepared minced chicken (1).

Spoilage due to *B. botulinus* can not always be determined by the appearance or odor of the food.

BIBLIOGRAPHY.

(1) Jordan, Food poisoning, Chicago, 1917, p. 3.
(2) Sheppard, South. California Pract., 1907, 22, p. 370.
(3) Peck, South. California Pract., 1910, 25, p. 121.
(4) Wilbur and Ophüls, Arch. Int. Med., 1914, 24, p. 589.
(5) Römer, Centralbl. f. Bakt., 1900, 27, p. 857.
(6) Savage, Food poisoning and food infections, 1920, p. 49.
(7) Schneidemuhl, Animalische Nahrungsmittel, 1903, Uhlenhuth and Hubner Kolle Wassermann Handbuch d. path. Mikroorg., 1913, III, p. 1038.
(8) Koser, Jour. Agricult. Res., 1920, 20, p. 375.
(9) Rosenberger, New York Med. Jour., 1920, 112, p. 222.
(10) Koser, Edmonson and Giltner, Jour. Am. Med. Assn., 1921, 77, p. 1250.
(11) Dickson, Jour. Am. Vet. Med. Assn., 1917, 50, p. 612.
(12) Buckley and Shippen, Jour. Am. Vet. Med. Assn., 1917, 50, p. 809.
(13) Graham, Kentucky Agricultural Exper. Station Bull., 207 & 206, 1917; Jour. Bacteriol., 1919, 4, p. 1 & 1921, 6, p. 69; University of Illinois Extension Circular No. 38, 1920.
(14) Graham and Schwarze, Jour. Infect. Dis., 1921, 28, p. 317.
(15) Wilkins and Dutcher, Jour. Am. Vet. Med. Assn., 1920, 57, p. 653.
(16) Saunders, Jour. Ark. M. Soc., 1915–16, 12, pp. 6–13, and Jour. Missouri Med. Assn., 1913–14, 10, p. 305.
(17) Dickson, Jour. Am. Vet. Med. Assn., 1920, 57, p. 75.
(18) Hart, Arch. Int. Med., 1918, 22, p. 490.
(19) Hart and Hayes, Jour. Am. Vet. Med. Assn., 1920, 57, p. 638.
(20) L. Pearson, Jour. Comparative Med. & Vet. Archiv., 1900, 21, p. 654.
(21) Kraus, Kantor and Quiroga, Revista d. Inst. Bacteriol. Buenos Aires, 1919, 2, p. 239.
(22) Udall, Cornell Veterinarian, 1913, June 17.
(23) McCarthy and Ravenel, Jour. Med. Research, 1903–4, 5, p. 243.
(24) Curfmann, Colorado Med., 1917, 14, p. 35.
(25) Rusk and Grindley, University of Illinois Agricultur. Exp. Stat. Bull., 210, 1918.
(26) Graham and Schwarze, Jour. Infect. Dis., 1921, p. 114.
(27) Graham and Schwarze, Jour. Bacteriol., 1921, 6, p. 69.
(28) Theiler, Jour. Depart. Agriculture, Union South Africa, 1920, June, Reprint 13.
(29) Meyer, Jour. Am. Vet. Med. Assn., 1916, 48, p. 552.
(30) Graham, Jour. Am. Vet. Med. Assn., 1921, 60, p. 76.
(31) Dickson and Shevky, Proc. Soc. Exp. Biol. & Med., 1921, 18, p. 313.
(32) Ophüls, Arch. Int. Med., 1914, 14, p. 589.
(33) Marinesco, Presse Med., 1897, 5, p. 41.
(34) Graham and Schwarze, Jour. Am. Med. Assn., 1921, 76, p. 1743.
(35) Bengtson, Public Health Rep., 1921, 36, p. 1665.
(36) Orr, Jour. Infect. Dis., 1921, 29, p. 287.
(37) Meyer and Geiger, Public Health Reports, 1921, 36, p. 1313.
(38) Kob, Med. Klinik, 1905, 1, p. 84.
(39) Semerau and Noack, Ztschr. f. Klin. Med. 1919, 88, p. 304.
(40) Graham, University of Illinois Extension Circular No. 38, 1920, p. 5.
(41) Orr, Proc. Soc. Exp. Biol. & Medicine, 1919, 17, p. 47.

(42) Edmondson, Giltner and Thom, Arch. Int. Med., 1920, 26, p. 357.
(43) V. Burke, Elder and Pischel, Arch. Int. Med., 1921, 27, p. 265.
(44) Randall, Med. Rec., 1920, 98, p. 763.
(45) Weinzirl, Jour. Med. Res., 1919, 39, p. 349.
(46) Cheyney, Jour. Med. Res., 1919, 40, p. 177.
(47) L. Bitter, Deutsch. Med. Wchnschr., 1919, 45, p. 1300.
(48) Landmann, Hyg. Rundsch., 1904, 14, p. 449.
(49) Gaffky, Lafar's Handbuchd. technisch. Mykologie, 1905–8, 2, p. 453.
(50) Leuchs, Ztschr. f. Hyg. & Infektions Kr., 1910, 65, p. 55.
(51) van Ermengem, Ztschr. f. Hyg. & Infektions Kr., 1897, 26, p. 1.

ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
15 CENTS PER COPY
▽

TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 128

DECEMBER, 1922

LIBRARY OF
S. H. OSBORN M. D.

TRANSACTIONS OF THE TWENTIETH ANNUAL CONFERENCE OF STATE AND TERRITORIAL HEALTH OFFICERS WITH THE UNITED STATES PUBLIC HEALTH SERVICE

NOV 7 19

HELD AT WASHINGTON, D. C.
MAY 17 AND 18
1922

WASHINGTON
GOVERNMENT PRINTING OFFICE
1922

CONTENTS.

Page
Standing committees IV
Provisional program V
List of speakers VII
Morning session, May 17, 1922 1
  Delegates present 1
  Opening remarks of the Surgeon General 3
  Reports of committees 4
    Sanitation of public conveyances 4
  Cooperation of women's organizations 8
  Announcement of members of resolutions committee 11
  Trachoma 11
  Board on excreta disposal 13
  Value of comparative data 24
  Anthrax 25
  Chlorine as a means of insuring the safety of drinking water 29
Afternoon session, May 17, 1922 32
  Tour of Arlington County, Va 32
  Rural health work 32
Morning session, May 18, 1922 39
  Address by Col. Edward Clifford, Assistant Secretary of the Treasury 40
  Cooperative certification procedure 45
  Colon bacillus as an index of potability of water 47
  Toxin-antitoxin and the Schick reaction 52
  Effect of distribution by official agencies of biologic products on child morbidity and mortality 58
  Standardizing technique 60
  Cooperative malaria control work 66
  Methods of evaluation of results of local measures for the control of malaria 70
  Registration area for morbidity 77
  Proposed program for venereal diseases for the ensuing fiscal year 81
  Transportation of lepers 87
Afternoon session, May 18, 1922 90
  Uniform parole system for lepers 91
  Child hygiene 94
  Provisions of the act of November 23, 1921, entitled "Promotion of the welfare and hygiene of maternity and infancy, and for other purposes" 102
  Nutritional disease 103
  Vaccination against smallpox 103
  Report of resolutions committee 107
  Industrial sanitation 110
  Education of sanitarians 112
  Rabies eradication by vaccination of dogs 115

ILLUSTRATIONS.

FIGURE 1. Tube rack 14
2. Tube rack 15
3. Pipette well 16
4. Pipette well 16

STANDING COMMITTEES.

Morbidity Returns.

Dr. Eugene R. Kelley, chairman.
Dr. G. Hampson Jones.
Dr. B. S. Warren.

Sanitation of Public Conveyances.

Dr. Oscar Dowling, chairman.
Dr. J. N. Hurty.
Dr. T. B. Beatty.
Dr. W. F. Cogswell.
Dr. Victor G. Heiser.

Interstate Quarantine Regulations.

Dr. John S. Fulton, chairman.
Dr. E. G. Williams.
Dr. C. E. Smith, jr.
Dr. S. J. Crumbine.
Dr. T. B. Beatty.
Dr. A. J. McLaughlin.

Rural Health Work.

Dr. W. S. Rankin, chairman.
Dr. C. E. Dalton.
Dr. J. A. Hayne.
Dr. L. L. Lumsden.

Trachoma.

Dr. John McMullen, secretary.

PROVISIONAL PROGRAM.

Opening remarks by the Surgeon General.
Roll call of delegates.
Appointment of committees.

REPORTS OF STANDING COMMITTEES.

Morbidity returns—Dr. Eugene R. Kelley.
Sanitation of public conveyances—Dr. Oscar Dowling.
Interstate quarantine regulations—Dr. John S. Fulton.
Rural health work—Dr. W. S. Rankin.
Trachoma—Dr. John McMullen.

SPECIAL REPORT.

Progress report of board appointed by the Surgeon General to study the problem of sanitary disposal of human excreta in unsewered communities—Prof. C. W. Stiles.

NEW BUSINESS.

Anthrax.
Discussion of amendments to interstate quarantine regulations.
Problems of interstate health work:
    Control of water supplies used in interstate traffic.
        Discussion of chlorine as a means of insuring the safety of drinking water.
        The value of colon bacillus as an index of potability of water.
        Cooperative certification procedure.
Coordination of effort and promotion of efficiency in the field of sanitary engineering.
Transportation of lepers:
    Uniform parole system.
Trachoma.
Cooperative malaria control work:
    Paris green as a larvicide.
    Methods of evaluation of results of local measures for the control of malaria.
Registration area for morbidity.

The relation of the public and the medical profession in the conservation of health.

Venereal diseases:

- Proposed program for the ensuing fiscal year.
- State work in venereal-disease control.

Cooperative rural health work.

Child hygiene:

- Résumé of activities of the Public Health Service.
- Provisions of the act of November 23, 1921, entitled "Promotion of the welfare and hygiene of maternity and infancy, and for other purposes," with special reference to detailed plans for carrying out the provisions of the act as specified in section 8.
- Effect of distribution by official agencies of biologic products on child morbidity and mortality.

Toxin-antitoxin and the Schick reaction:

- State-wide programs for the application of the Schick test and toxin-antitoxin immunization.
- Standardizing technique.

Sanitary supervision of milk supplies.

Nutritional diseases.

Vaccination against smallpox.

Industrial hygiene.

Report of the conference on the education of sanitarians.

Immigration problems.

Rabies eradication by vaccination of dogs.

LIST OF SPEAKERS.

Page.
Opening remarks by Surg. Gen. Hugh S. Cumming........ 3
Sanitation of public conveyances:
    Dr. O. Dowling........ 5
    Dr. J. A. Hayne........ 5
    Dr. A. W. Freeman........ 5
    Dr. S. W. Welch........ 5
    Dr. A. W. Freeman........ 6
    Dr. I. H. Dillon........ 6
Cooperation of women's organizations:
    Dr. E. B. Thelberg........ 8
Trachoma:
    Dr. John McMullen........ 11
Board of excreta disposal:
    Dr. C. W. Stiles........ 13
    Mr. O. E. Meinzer........ 21
Remarks by Mrs. William Tilton........ 24
Anthrax:
    Dr. R. H. Creel........ 25
    Dr. C. F. Dalton........ 28
    Dr. A. J. McLaughlin........ 28
Announcement by—
    Dr. E. G. Williams........ 28
    Dr. L. L. Lumsden........ 29
Chlorine as a means of insuring the safety of drinking water:
    Mr. Sol Pincus........ 29
Rural health work:
    Dr. W. S. Rankin........ 32
    Dr. L. L. Lumsden........ 36
Address by—
    Assistant Secretary E. Clifford........ 40
    Dr. S. W. Welch........ 44
Cooperative certification procedure:
    Mr. C. A. Emerson........ 45
    Dr. S. W. Welch........ 46
    Dr. T. B. Beatty........ 47
    Dr. A. J. Chesley........ 47
Colon bacillus as an index of potability of water:
    Dr. W. H. Frost........ 47
    Dr. C. W. Garrison........ 51
    Dr. W. H. Park........ 51
    Dr. C. W. Stiles........ 51

Toxin-antitoxin and the Schick reaction: Page.

Dr. W. H. Park 52

Effect of distribution by the official agencies of biologic products on child morbidity and mortality:

Dr. J. A. Hayne 58

Standardizing technique:

Dr. G. W. McCoy 60
Dr. I. H. Dillon 61
Dr. I. D. Rawlings 62
Dr. J. S. Mitchiner 62
Dr. W. H. Park 63

Malaria:

Dr. L. D. Fricks 66

Methods of evaluation of results of local measures by the control of malaria:

Mr. L. M. Fisher 70
Dr. J. A. Ferrell 73
Dr. S. W. Welch 74
Dr. A. T. McCormack 75

Registration area for morbidity:

Dr. J. S. Fulton 77
Dr. B. S. Warren 78

Venereal diseases:

Dr. C. C. Pierce 81
Dr. Wm. F. Snow 86
Dr. C. W. Stiles 87

Transportation of lepers:

Dr. A. J. Chesley 87
Dr. A. T. McCormack 88
Dr. J. W. Schereschewsky 88
Dr. S. W. Welch 88
Dr. C. W. Stiles 89
Dr. J. S. Fulton 89
Dr. L. L. Lumsden 89

Uniform parole system:

Dr. F. E. Trotter 90
Dr. C. W. Garrison 92
Dr. G. W. McCoy 93
Dr. S. J. Crumbine 94
Dr. A. J. Chesley 94

Child Hygiene:

Dr. T. Clark 94

"Promotion of the welfare and hygiene of maternity and infancy:"

Dr. J. W. Schereschewsky 101
Miss Grace Abbott 102

Nutritional disease:

Dr. J. Goldberger 103

Smallpox vaccination:

Dr. J. P. Leake 103
Dr. T. B. Beatty 106
Dr. P. A. Turner 106

Report of resolutions committee: Page.
Dr. C. F. Dalton 107
Dr. J. S. Fulton 108
Dr. I. H. Dillon 109
Dr. A. J. Chesley 110
Industrial hygiene:
Dr. L. R. Thompson 110
Education of sanitarians:
Dr. A. J. McLaughlin 112
Immigration:
Dr. J. W. Kerr 113
Vaccination against rabies:
Dr. A. M. Stimson 115
Dr. T. B. Beatty 116
Dr. S. W. Welch 117
Dr. A. M. Stimson 118

TWENTIETH ANNUAL CONFERENCE OF STATE AND TERRITORIAL HEALTH AUTHORITIES WITH THE UNITED STATES PUBLIC HEALTH SERVICE.

TRANSACTIONS.

MORNING SESSION, WEDNESDAY, MAY 17, 1922.

The Twentieth Annual Conference of State and Territorial Health Authorities with the United States Public Health Service was called to order at 10 o'clock a. m., May 17, 1922, at the American Red Cross Building, Washington, D. C., Surg. Gen. Hugh S. Cumming presiding.

The following persons were present during the conference:

REPRESENTATIVES OF THE STATE HEALTH DEPARTMENTS.

Alabama: Dr. S. W. Welch.
Arkansas: Dr. C. W. Garrison and Mr. M. Z. Bair.
California: Dr. S. W. Hazelhurst.
Connecticut: Dr. John T. Black and Mr. J. F. Jackson.
District of Columbia: Dr. W. C. Fowler.
Hawaii: Dr. F. E. Trotter and Mr. S. W. Tay.
Illinois: Dr. J. D. Rawlings and Mr. H. F. Ferguson.
Indiana: Dr. W. F. King.
Iowa: Dr. R. P. Fagen and Mr. H. V. Pedersen.
Kansas: Dr. S. J. Crumbine.
Kentucky: Dr. A. T. McCormack.
Louisiana: Dr. Oscar Dowling.
Maine: Dr. C. F. Kendell.
Maryland: Dr. John S. Fulton, Mr. C. H. Jones, and Mr. R. B. Morse.
Minnesota: Dr. A. J. Chesley and Mr. H. A. Whittaker.
Mississippi: Dr. H. Hays.
Montana: Dr. W. F. Cogswell.
Nebraska: Dr. I. H. Dillon.
New Jersey: Dr. R. B. FitzRandolph and Dr. A. J. Casselman.
New York: Dr. J. S. Lawrence, Dr. M. Nicoll, jr., and Mr. Theodore Horton.

North Carolina: Dr. W. S. Rankin, Dr. H. E. Miller, and Dr. J. S. Mitchiner.

Ohio: Dr. H. H. Snively, Dr. James E. Bauman, and Mr. W. H. Dittoe.

Oregon: Dr. F. B. Stricker.

Pennsylvania: Mr. C. A. Emerson.

Rhode Island: Dr. B. U. Richards and Mr. Stephen De M. Gage.

South Carolina: Dr. James A. Hayne and Dr. E. L. Filby.

Tennessee: Dr. W. J. Miller, Dr. R. Q. Lillard, and Mr. C. N. Harrub.

Texas: Dr. W. H. Beazly and Mr. V. M. Ehlers.

Utah: Dr. T. B. Beatty.

Vermont: Dr. C. F. Dalton.

Virginia: Dr. E. G. Williams and Dr. R. K. Flannigan.

Washington: Dr. Paul A. Turner and Mr. C. E. Dorisy.

West Virginia: Dr. W. T. Henshaw, Mr. E. S. Tisdale, and Mr. J. T. Dillon.

Wisconsin: Dr. L. W. Hutchcroft.

REPRESENTATIVES OF THE UNITED STATES PUBLIC HEALTH SERVICE.

Surg. Gen. Hugh S. Cumming.

Asst. Surgs. Gen. C. C. Pierce, C. H. Lavinder, J. W. Kerr, J. W. Schereschewsky, A. J. McLaughlin, R. H. Creel, and B. S. Warren.

Directing Zoologist (R.) C. W. Stiles.

Senior Surg. Benjamin W. Brown.

Surgs. John McMullen, L. L. Lumsden, G. W. McCoy, L. D. Fricks, T. Clark, J. Goldberger, L. R. Thompson, J. P. Leake, A. M. Stimson, W. F. Draper, and W. H. Frost.

Passed Asst. Surg. M. V. Ziegler.

Associate Sanitary Engineers Sol Pincus, L. M. Fisher, and H. W. Streeter.

Assistant Sanitary Engineer I. W. Mendelsohn.

GUESTS.

Miss Grace Abbott.
Miss S. C. Barks.
Col. Edward Clifford.
Dr. Harold S. Diehl.
Mrs. Sarah C. Fernandis.
Dr. John A. Ferrell.
Dr. A. W. Freeman.
Dr. L. R. Goldsmith.
Miss Matilda Lindsay.
Miss Agnes Meagher.
Dr. Lena L. Meanes.
Mr. O. W. Meinzer.
Dr. William H. Park.
Dr. Valeria Parker.
Mrs. E. C. Slagle.
Dr. William F. Snow.
Dr. Elizabeth B. Thelberg.
Mrs. Elizabeth Tilton.
Dr. Rachel Yarros.

OPENING REMARKS BY THE SURGEON GENERAL.

Doctor CUMMING. Will the conference please come to order, as we have a rather full program which we desire to complete.

I take pleasure in opening this, the Twentieth Annual Conference of State and Territorial Health Officers with the United States Public Health Service, and in expressing my thanks to you as health authorities of your States and representatives of your State governments for being present at the conference, because I know how many conferences you have attended in the past few months and how many are ahead of us.

I think it is rather encouraging that in spite of the reactionary feeling with regard to appropriations which followed the war, appropriations for the Federal service and, as far as I gather from State officials, State appropriations have not been reduced. I think that is a matter for congratulation.

The service fared pretty well during the present year so far as appropriations are concerned. Congress and the legislatures have been fairly liberal, under the circumstances, showing that the importance of public health is beginning to be appreciated.

So far as the Federal service is concerned, despite the feeling that the ex-service man problem interfered with us, we really have been doing more cooperative work than ever before with the State and Federal departments.

This particular phase of the Public Health Service work is developing very rapidly, and the sympathetic attitude of the President, the Postmaster General, Dr. Hubert Work, and other members of the Cabinet will, I am sure, result in good to the States and to the Federal Government.

With the acquisition of the New York quarantine station the Federal control of national quarantines is now complete.

Since our last meeting there have been fundamental decisions of the Supreme Court which pretty clearly outlined the police powers of the Federal Government with relation to the States. If you have not read the decisions relative to the child-labor act, I advise you to do so, because there is a good deal of misapprehension along that line.

I feel that with the outline of the legal responsibility before us there is a greater need for close and sympathetic cooperation in the problems which we mutually have to attack, and I am thankful to say that, so far as I am aware, there has never been better understanding and coordination of effort than there has been between ourselves during the past year or so.

I am not going to take the time to go over the events of the last 12 months. Some of the things are of sufficient importance to mention—for instance, the growing realization of the fact that the development of adequate local health service is the principal means for the protection of the health of the citizen; and the necessity for better health protection during the age of infancy, growth, and development.

In addition to the attention which has been called to these fundamental principles, progress has been made during the year on the problem of eliminating malaria from the United States. When this shall have been successfully accomplished we may expect an increase of at least 30 per cent in the health and prosperity of those sections of our country where this disease is now prevalent.

Another significant thing is the recent conference between the Public Health Service and educational authorities respecting the problem of supplying trained workers in the field of public health. This has more than a surface significance, for it surely indicates that the demand for trained health workers is beginning to outrun the supply, showing that advances in the extension of public health work are pending and that the future is bright with possibilities.

I will not take time to speak longer. The program is full and offers many important subjects for discussion.

I bid you a most hearty welcome and declare the Twentieth Annual Conference of the State and Territorial Health Officers with the United States Public Health Service now open. Since this conference is the legal machinery through which the State health authorities have their advisory voice in Federal health matters, let me urge upon you the duty you have of fully expressing yourselves upon these matters, not only with respect to the program but about any other line affecting the relations of the Federal Health Service with the States.

(The secretary called the roll.)

Doctor CUMMING. In view of the large number of people present here this morning, it may be well for me to state that this is an official gathering, representing the States, and when the question of voting comes up the only people entitled to vote will be the official representatives of the State governments.

The first thing in order is the report of the standing committee, morbidity returns, by Dr. Eugene R. Kelley. Doctor Kelley told me he had to return to Massachusetts, and I do not know whether he left anybody to report for him.

(No response.)

Sanitation of public conveyances, by Dr. Oscar Dowling.

SANITATION OF PUBLIC CONVEYANCES.

Doctor DOWLING. There is really nothing new to offer, but I have submitted for the committee a short report.

Doctor Dowling thereupon read the following report of the committee:

REPORT OF COMMITTEE ON SANITATION OF PUBLIC CONVEYANCES.

Your Committee on Sanitation of Public Conveyances begs to report that the recommendations made in 1921 are sufficiently adequate if they could be enforced.

We make two additional suggestions—more as suggestions than recommendations—namely, that spittoons with running water, similar to the dental arrangement of lavatories, be placed in smoking rooms and parlor cars; and that, if at all practicable, ceiling fans additional to those at the end of the cars be placed in all coaches where electric fans are now used.

Doctor **Cumming**. Gentlemen, you have heard the report. Is there any discussion? What will you do with this report?

Doctor **Hayne**. Will the secretary read it? I do not think the members grasped the significance of it.

Doctor **Schereschewsky**. The secretary will read the report again.

(The secretary thereupon read the report.)

Doctor **Dowling**. For those recommendations you are referred to the report of the transactions of the last conference. We make two additional suggestions—more as suggestions than recommendations. They are as follows:

(Doctor Dowling read the recommendations or suggestions above referred to.)

Doctor **Freeman**. I do not know whether I have the privilege of the floor at this gathering or not, but if I understand the action of the conference taken on the report of the committee on railroad sanitary regulations it provided that no action should be taken for a five-year term. We have just completed a very long drawn-out discussion, getting everybody to agree to the sanitary regulations. If we argue for two days on that set of records, we will be where we were and work done on that will be lost, and I would suggest that these suggestions be referred to a standing committee or a special committee on amendments. If we do anything now, it will throw the whole thing into chaos.

(It was moved and seconded that the matter be referred to a committee.)

Doctor **Welch**. These things suggested for amendment are referred to the executive committee of State and Provincial health officers, and I would be inclined to accept the report. The general code has been published, distributed, and adopted by the State of Alabama, and we do not want to be bothered with adopting more amendments. We have adopted some amendments, and they have not gotten cold from their adoption. Since these have been printed, we are opposed to any amendment of the code at the present time.

Doctor CUMMING. The Chair will entertain a motion to lay it on the table.

Doctor WELCH. I move that it be laid on the table.

A MEMBER. I second it.

Doctor CUMMING. All in favor of laying the motion on the table for the present time will say "aye."

(Motion carried.)

A MEMBER. There will be no need for continuing the committee, will there? If you are only going to take it up within five years time there is no need of the committee.

Doctor DOWLING. I move that the committee be discharged with the thanks of the conference.

Doctor CUMMING. Is there any discussion on this?

Doctor DOWLING. I want to say this: I will read the report:

(Doctor Dowling thereupon read the report.)

This was merely a suggestion, not a recommendation. As I said, if you are not going to consider anything except in five years, it would be carrying dead matter to carry a committee.

Doctor CUMMING. I was not attempting to influence the decision. I suggested one method of disposing of it, temporarily laying it on the table. I have not appointed a committee. I can take it up at any time. The Chair is a little confused about the parliamentary condition of the motion, and particularly with reference to the committee to which Doctor Freeman alluded. What committee is that?

Doctor FREEMAN. The committee on standard railway sanitary code, and the provincial health officers, which has just completed the work of getting everybody into agreement on the problem, and which I think was discharged at the meeting just held.

A MEMBER. That is correct, and the report was approved by the service and distributed.

Doctor CUMMING. The Chair does not claim to be a parliamentary expert at all, unfortunately, and we want to dispose of this thing after a full discussion. I am open to suggestion as to what to do about it.

Doctor DILLON. A standard railway code has been promulgated and adopted by a number of States, and it will be adopted by other States. It seems to me the height of folly to change the code just as soon as you have adopted it, by making minor changes in it, and I believe that a period once every five years for a revision of that code is amply often to revise it or change it to meet the growing conditions and growing needs, and I see no reason why suggestions of this kind should be adopted or rejected one way or the other. If they are adopted now and held in abeyance for four or five years they are forgotten, and it occurs to me, if a committee could be appointed in 1924 to begin considering the things that will come up for revision at the end of the five-year period, that that would be the time to begin making reports for the change of rules on sanitation of railway coaches and conveyances.

Doctor Dowling. May I say for the committee that the report is as follows:

(Doctor Dowling thereupon read the report.)

I think you will do remarkably well if you enforce them. I am willing to withdraw the suggestion, with the hope that it will be enforced, and I would like to have somebody report from one State where they have been enforced.

Doctor Cumming. This is the original report.

Doctor Dowling. We will withdraw the suggestion. It was made as a suggestion, and not to be adopted as a regulation. It is made as a suggestion, food for thought. You will all agree that expedients invite spitting, and of all the people that should not spit are the health officers of the various States of the United States.

A Member. I move that the amended report be received.

Doctor Cumming. Is there any discussion?

A Member. I second it.

Doctor Cumming. All in favor of the adoption of the amended report will so signify by saying "aye."

(The report, amended by leaving out the second paragraph, was adopted.)

Doctor Cumming. The report on interstate quarantine regulations, Dr. John S. Fulton.

Doctor Fulton. No suggestions of any kind modifying the interstate quarantine regulations have come to my knowledge, so there is, therefore, no report.

Doctor Cumming. Report on rural health work, Dr. W. S. Rankin.

Doctor Rankin. I would like to suggest that that be postponed until the afternoon session.

Doctor Cumming. Is that agreeable to the chairman of the committee?

Arrangement has been made with Doctor Williams for the conference, after the lunch-time period, to meet in the Arlington County courthouse, to give Doctor Williams an opportunity to show some sanitary work. He consulted with most of you gentlemen, and it is agreeable. Conveyances will be down here to carry you over to meet in Arlington County courthouse.

The report on trachoma, Dr. John McMullen.

Doctor Pierce. If Doctor Rankin will give his report this afternoon, I would ask that Miss Thelberg be given the floor at this time.

She wants 10 minutes to show how women's organizations can cooperate.

Doctor CUMMING. Is there any objection?

(No objection.)

COOPERATION OF WOMEN'S ORGANIZATIONS.

Doctor THELBERG. Officers of the State and Territorial health authorities, to whose kindness I owe this opportunity to present just the merest glimpse of what we women want, what we are interested in, and how most of all we want to help you in your State and Territorial work, it requires some courage to face so large a body of distinguished men and women, but courage is a relative thing, you know.

You have all heard of the man who slept with lions. This man was a menagerie keeper, and before the passage of the eighteenth amendment he came home and did not like to go upstairs. Then he bethought himself of the lion's cage, and after hesitating awhile he went across the street into the stables where the animals were kept, and he rolled back the door of the lion's cage and crept in and spent the rest of the night. In the morning his wife awakened and found that he was not by her side, and she was very angry. She could not find him anywhere, until it occurred to her that she must feed the animals, and she hurried across the street and looked in the door of the lion's cage and saw her husband lying alongside of the lion, and she said, " Come out of there, you coward."

It is not a matter of cowardice.

We thank you for asking us all here, and I thank you personally for giving me the chance to tell you that story and say some other things. You will remember the story.

I want to tell you about our meeting yesterday. We had a meeting of the advisory council, and it was a most instructive and interesting day. We had the very great pleasure of listening to Doctor Hamilton, and we were so proud. I wish that you could have heard Doctor Hamilton speak. The doctor is perhaps the greatest authority upon industrial hygiene, not only in America but in the world. We are indebted to her and others who instructed us yesterday.

We passed some resolutions in relation to industrial hygiene. We feel, as women workers, that we are too profoundly ignorant about the basis of industrial hygiene; and I am sure that the resolution we passed in our hearts as well as those we passed on paper will be handed up higher, and we will be stimulated by that meeting yesterday, become more intelligent in relation to the basis of industrial hygiene, and we will endeavor to extend that intelligence into the organizations which we represent, and, further, into the educational institutions which some of us represent and in which all of us are profoundly interested.

Is there any reason why courses in general sanitation, with particular attention paid to industrial hygiene, should not be put into our colleges, both for men and for women? Is it not possible that our Government in general or the two Houses of Congress might be made more intelligent if during their college days or later high-school days the Members should have had the benefit of such a course? Would not health conditions improve by the introduction of such courses in our schools? We teach a great many things which are infinitely less interesting and less important to life in general than such courses would be.

About yesterday: In relation to our present fears, I want to tell you one or two things. You do not know how interesting these women in the back of the room with you are. For instance, we have with us Mrs. Fernandis, who represents 250,000 colored women of America, all organized into well, finely acting, intelligent club people. That is a tremendous force, a force to be reckoned with in the work which we want to do among people of her color in this country of ours.

I sat, during the international council in Norway, during that whole 10 days by the side of the then president of the colored women's organization, a graduate of Oberlin University. She is of a family of 10 children, and all of them are college graduates; Mrs. Talbot was most honored in Norway, and was a great and valuable addition to the intelligence of the American women's council delegation.

We have here also Mrs. Tilton, of Massachusetts, who represents 300,000 women, the Parent-Teachers and Mothers' Congress Association. If you could secure the votes of those women in sanitary measures in all the States of the Union, you would carry many things which you find difficult now.

Also we have with us Mrs. (also Doctor) Goldsmith, of Pittsburgh, who represents the Jewish Women's Council of America, not thousands, but a million women of extraordinary intelligence, of extraordinary interest in matters pertaining to the welfare of the country, which is our country.

We also have a representative of the Medical Women's National Association here, not thousands, hundreds, but a very great number, picked women, women of great power in their communities, and women whose power is being extended by the closest cooperation with the women of their vicinities or the communities in which they dwell.

We have also a representative of the Women's Foundation of Health, which represents 14 national societies. That runs up into the millions. They have a great ideal, those women have.

You remember when Jean Paul Richter lay dying he said, "Give me a great thought that I may quicken myself with it." These women have gotten hold of a great thought, the thought of health, as a positive factor in human life. We have that thought and are looking forward, but they are advancing that thought, trying to advance health as a new presentation of a thought, and they are also becoming more and more tremendously powerful, and their power is added to by the fact that they represent the hundreds of thousands of women of the Y. W. C. A., one of the strongest factors for good in our land.

We have representatives of the League of Catholic Women, which runs again into millions.

We have a representative of the League of Women Voters, hundreds of thousands, represented by women of great ability.

We have the General Federation of Women's Clubs. With that association, to which, I suppose, most of your wives belong, you are more familiar. Four million women are incorporated into the women's clubs in this country. Think of the power for good, and the possible power for evil. They may be led astray here and there by faddists and by quackery, but it is up to us and to you to educate them so that they will be sane on all these subjects.

These four million organized women are much more in the habit of addressing audiences than I am. It will never be said of them as it was said of a Senator some time ago. He had been talking for two hours, and somebody said, "The Senator has been talking for two hours." "What about?" "He did not say." When they talk they know what to say.

We have a representative of the National Council of Women of America representing 11,000,000 women. That is a good many women, isn't it? It is frightful to think of. Matthew Arnold said a long time ago that if women ever got together for a good purpose they could make the world over. You have given us the vote. Some of us are ready and some of us are not ready, but we want to get ready. It is a source of great pride to us representatives of these hundreds of thousands of women that you ask us to come here to-day. Did you ever stop to think that we are all members or citizens of some State or Territory? We care for our State profoundly. We look upon you and upon your functions with (I do not think I go too far when I say this) reverence. It is one of the greatest things and greatest ambitions that any human being can look forward to, to be in charge of health conditions in a State or Territory. None of us women has done that yet, and perhaps none of us ever will, but, gentlemen, it is my opinion that the sooner we get into straight political lines of work, the better; not definitely for office, and yet there are women who adorn the office which they fill.

Is there a more useful woman than Dr. Josephine Baker, of New York City, who has so reduced the death rate in her city that it is lower than the rural death rate anywhere in our country?

We women have walked along the primrose paths of philanthropy a great many years. It taught us a great deal, but I firmly believe that if we are going to do the best job we can, we shall get in the straight path of politics; yes, even of political preferment—I am not ashamed of an ambition that way, though I have not any personally—but I have a great respect for the young woman who has, and I believe that we have exerted that influence of ours in unseen ways to little avail. There has been more talk than anything else. Why should not women have an ambition to be health officers in their town and village? Some of them have been fine. Why should not they get on the local health board? Why should they not effect good toward righteousness and toward that intangible thing which we call health of mind, body, and spirit? We thank you for the opportunity of coming here and learning. We are perfectly conscious that we do not know the game yet. We want to learn. We learned yesterday and we are learning to-day.

I never attended a meeting in my life which so increased my intelligence as the meeting I attended in Boston with many of you gentlemen last year.

I am grateful to the Surgeon General for the invitation to that meeting, and I am sure that we are all grateful for the opportunity to be here with you to-day.

I thank you.

Doctor CUMMING. I am sure I express the views of all of you when I thank the preceding speaker for the interest of the women in our work.

Doctor SCHERESCHEWSKY. I will announce the members of the resolutions committee. They are Doctors Dalton, Fulton, Crumbine, Hayne, Dowling, Rankin, and Stricker.

Doctor CUMMING. We will now hear from Doctor McMullen.

TRACHOMA.

Doctor MCMULLEN. Mr. Chairman and gentlemen of the conference, the trachoma work has been conducted in much the same manner as in previous years. The outstanding features this year are the clinics and the establishment of an additional hospital in Arkansas, with the thorough cooperation of the State board of health, Doctor Garrison, and the local authorities.

The most prominent piece of trachoma work during the year was a clinic conducted in south Georgia. It was a great surprise to me, and I presume it will be to a number of you, to know that in one of the counties of south Georgia we found active communicable trachoma existing in about the same way that we have heard so much about and for so long a time in eastern Kentucky and Tennessee. The investigation was made in the fall, at the request of the State health officer. I personally made the investigation and found entire families with trachoma. Not a few of these had lost their sight entirely, and even more had lost the sight of one eye. It was very interesting to trace the origin of this disease. It dated back about four generations, where it was lost. I noticed that the State health officer of Florida did not respond to his name a few minutes ago, so I will not say much about that. The lady who was the mother of some of the trachoma patients, and a patient herself, stated that her mother had spent a portion of her childhood in Florida and had suffered with sore eyes at that time. I wish the Florida health officer were here.

The clinic in south Georgia was conducted by the service, which furnished medical officers and two nurses; the county furnished the building, which was a very modern hospital, built by some doctor two years ago in the hope of conducting a successful hospital. This small hospital went the way of the usual small institution and did not pan out economically, with the result that it was closed. The county was, therefore, able to obtain the vacant building. The clinic lasted four and a half months—November 14, 1921, to April 1, 1922. The attendance was more than 3,000—the trachoma cases amounted to nearly 300—and the operations were 381. I might add that all of the operations were not on trachoma. At the request of the State health officer, the local doctors, the commissioners who paid the bills, and the eye specialists we undertook to treat indigent cases. The operations included anything from cataract to tonsils, adenoids, etc. It might be said that these cases were done as an accommodation to the county commissioners.

The general trachoma work included 27 clinics in rural communities. At these clinics more than 5,000 people were examined. Six hundred and eighty-six cases of trachoma were found. Four hundred and ninety-eight operations were performed, 158 being done under general anesthetic.

These clinics were held in various States, the majority of them in Kentucky. Some were in Ohio, Texas, Mississippi, Tennessee, and North Carolina.

The State of Kentucky has now a bureau of trachoma which is cooperating with the service trachoma work. Other States are becoming more interested in the trachoma problem.

These, then, are the outstanding features of the work for 12 months. The sixth hospital has been in operation only a few weeks, having been opened in Arkansas about the middle of April. The total attendance at the other five hospitals during the year was 6,532. There were 561 cases of trachoma among those applying for treatment and 687 operations performed. Eight hundred and fifteen cases were admitted to the hospitals for treatment. The cost of operating the hospitals is very low, the average cost of feeding the patients being about 50 cents per day each, though a properly balanced diet for the patients is part of our treatment. As I have previously stated, these hospitals are conducted purely in the interest of public health and not primarily for the treatment of disease, and the patients are taught hygienic living, the fruit of these teachings often being the higher mental, moral, and physical standards that are attained.

Doctor Cumming. At the request of the Veterans' Bureau we are devoting a hospital now to the treatment of trachoma among ex-service men. This is a very recent thing, since the President's order.

The next report is a special report by Doctor Stiles—a progress report of the board appointed by the Surgeon General to study the problem of sanitary disposal of human excreta in unsewered communities.

ANNUAL (1921–22) REPORT OF THE BOARD ON EXCRETA DISPOSAL, PRESENTED TO THE STATE HEALTH OFFICERS' CONFERENCE, MAY 17, 1922.

Doctor Stiles submitted the following report:

From some points of view the Government fiscal year 1921–22 has been the most exceptional of the past 31 years.

Changes in Government methods as respects certain routine procedures in business matters, changes in methods of accounting, insufficient number of permanent personnel, uncertainty as to the future on the part both of permanent and temporary, statutory and lump sum, commissioned and civil service personnel, increase in reports required, but without corresponding increase in personnel, orders to save every dollar possible and in addition to save 10 per cent of allotments, numerous circular letters of instructions, or inquiry of all types, etc., have all combined to render this transitional year one of unusual difficulty in progressive work.

This is neither a complaint nor an apology, but simply a statement of fact.

One might wonder how this transition could seriously affect the work of a small unit like that of the board on excreta disposal. Permit me to mention two points in particular.

Never during 31 years of Government service have I known any more ardent desire and conscientious effort on the part of a major bureau to expedite requisitions than has obtained this past year in the Surgeon General's Office, and never have I experienced so many delays in obtaining supplies. As soon as the new order of affairs shall have passed from the transitional stage to a settled routine, these delays (which are at present unavoidable) will doubtless decrease both as to number and as to time. But, speaking from no small experience in Government life, I can not escape the conclusion that in the days of 1891 to 1900 the economy in a field unit was greater than it is to-day, and that this fact was due largely to the greater decentralization of purchasing—a plan which was rendered possible by the "Petit cash account" system then allowed to administrators whose work would be expedited thereby.

The delay in official work due to the fact that the present authorized personnel on a permanent basis is not sufficiently large to meet the exigencies of the service was well illustrated in our board, for we have lost our bacteriologist twice within less than 10 months and have been without a professional bacteriologist for a total of about three months. The bureau has done everything humanly possible to help us to meet the situation thus developed, but you can imagine the upset in a bacteriological research problem when one investigator not on a permanent status had to be released because of sound administrative reasons before his problem was completed, and when the bureau, because of limited personnel, saw no alternative and was compelled to take from us his successor—an excellent man—just after he had worked himself into his problem.

Much has been said in the public press about the expensive administrative methods in Government service. So far as the Public Health Service is concerned, as I look back over this past year, with the difficulties that arose in a small unit, I marvel at the fact that the Surgeon General, with his major unit and all of its many wheels, has been able to keep his machine running under the circumstances which faced him.

As stated a moment ago, these remarks are a frank statement of facts and are not to be interpreted either as a complaint as to conditions or as an apology for the point that I am about to report to you less complete results to-day than I had promised myself a year ago.

A. GROUND-WATER POLLUTION.—At your last conference I reported to you that a new and extensive experiment in ground-water pollution was being planned. Through the courtesy of the War Department, the board obtained the use of a very isolated portion of the Fort Caswell Reservation near Southport, N. C. At that place we started certain studies looking to the pollution of the ground water with typhoid fever, *Bacillus coli*, and uranin. I had fully expected to give you the summarized results at this meeting, but all I can do is to lay before you certain details.

We have a mass of data on the bacteria in the ground water, based upon a study of numerous samples taken under a rigid laboratory technique, but the bacteriologist who did the work was suddenly transferred in an emergency to other duty and it will take long and many hours to work up his notes, and a portion of the work must be delayed until a satisfactory successor is found. There are, however, several points in connection with the study which will be of practical interest to you.

(1) *Eaton's tube rack.*—While Acting Assistant Surgeon Eaton was with us as bacteriologist, he devised a very ingenious tube rack to reduce labor in culture tests on the *Bacillus coli* group, especially for typhoid, but which is of course applicable to other tests also. The device is along the general line of the apparatus described by Stimson and Neill (1918) [1] and used in testing disinfectants. We have found that it is a time-saver, hence a money-saver, and if it is new to you I recommend that you give it a trial. A sample rack (Figs. 1-2) is before you for examination.

This rack is made of galvanized iron and contains 20 sets of 6 culture tubes each (or, if one prefers, 6 sets of 20 culture tubes each), but with a common cotton plug for all 120 tubes; thus there is a great saving in the work as compared with plugging and unplugging each tube separately. For purpose of inoculation, the metal rack is placed at an angle in a wooden or a metal frame;

---

[1] Public Health Reports, 1918, v. 33(15), Apr. 12, 529–539.

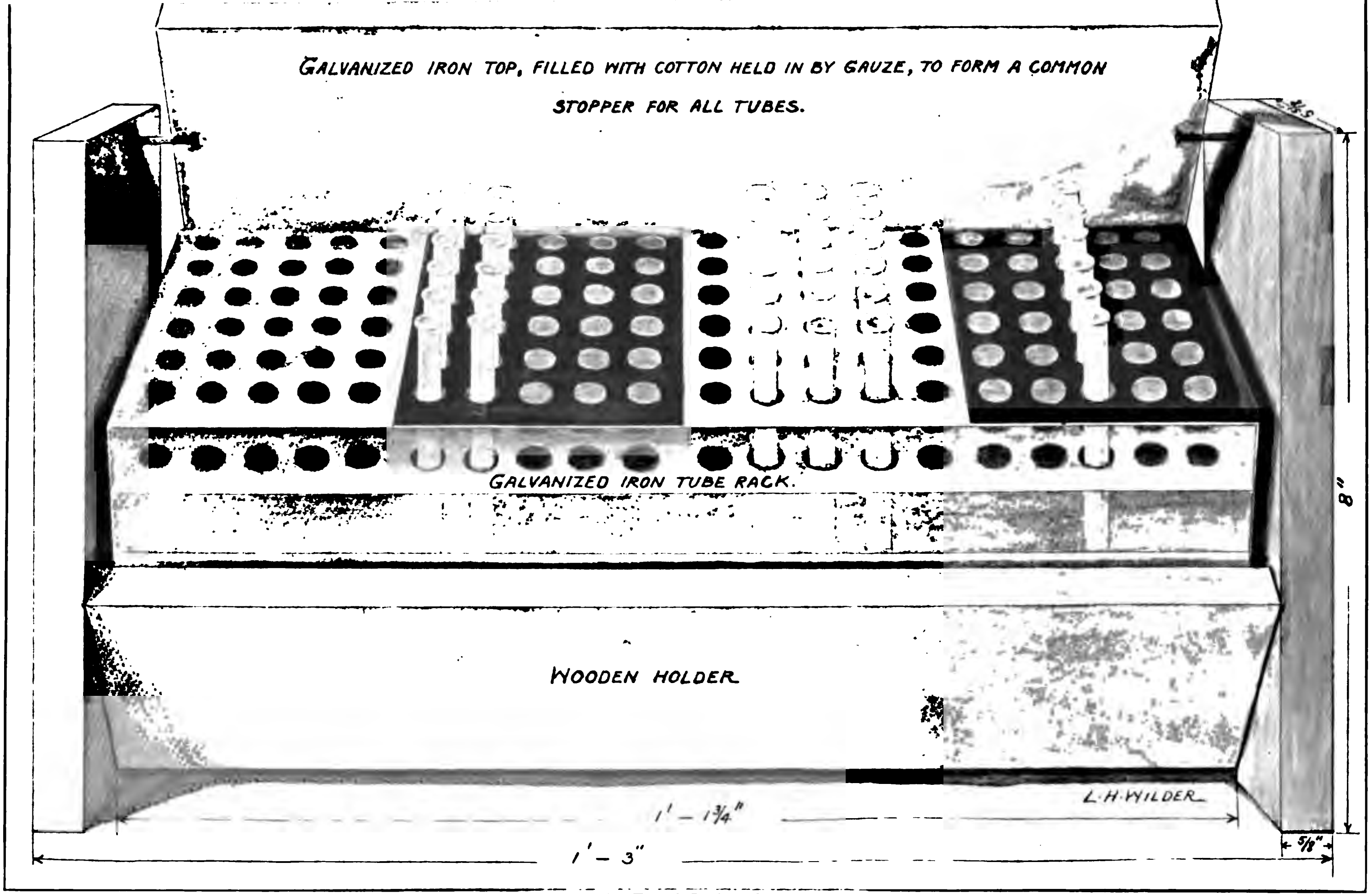

GALVANIZED IRON TOP, FILLED WITH COTTON HELD IN BY GAUZE, TO FORM A COMMON STOPPER FOR ALL TUBES.
GALVANIZED IRON TUBE RACK.
WOODEN HOLDER
L.H. WILDER
1' – 1¾"
1' – 3"
8"
⅝"
5⅛

FIG. 1.—TUBE RACK, OPEN.

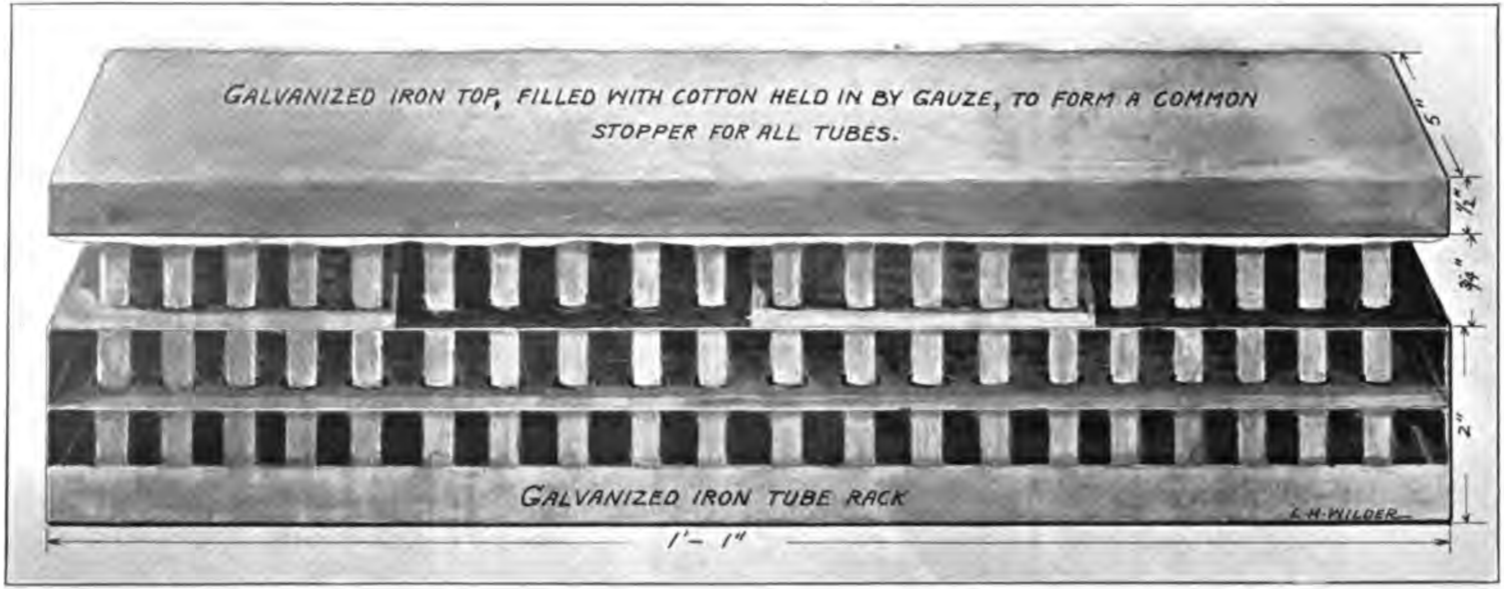

GALVANIZED IRON TOP, FILLED WITH COTTON HELD IN BY GAUZE, TO FORM A COMMON STOPPER FOR ALL TUBES.
5"
½"
¾"
2"
GALVANIZED IRON TUBE RACK
L. H. WILDER
1'– 1"

FIG. 2.—TUBE RACK, CLOSED.

the cover is raised and fastened but at an angle which shields the openings of the tubes from above. When the tubes are inoculated, the cover is pressed tight, thus plugging all tubes at once, and the rack is placed in the incubator, thus giving synchronous results on 20 samples for reaction with lactose, dextrose, maltose, mannite, litmus milk, and saccharose, and substituting two movements (one for plugging and one for unplugging) in the place of 240 movements (120 to plug, 120 to unplug).

(2) *Crohurst's pipette wells.*—The problem of obtaining underground water samples by a surgically aseptic technique, and at not too great expense, has at times presented difficulties, especially in view of the great number of tests that are necessary. Our sanitary engineer, H. R. Crohurst, has now solved the problem so far as our work is concerned, for he has devised two types of wells (Figs. 3–4) which are practically surgically aseptic pipettes. One of these types is so simple in its installation that a few days ago, under very favorable circumstances as to soil, he, with one helper, installed 21 of them in about one hour. The time necessary for installation varies, of course, with the nature of the soil and the depth of ground water.

Smaller pipette well: The well itself (fig. 3) consists simply of a one-eighth inch pipe of the desired length, with a copper screen at the lower end and an elbow with screw plug at the upper end. The hole in the ground is made by sinking a plunger. For this purpose we use either a one-eighth inch pipe threaded at one end on which a point is screwed, or if the resistance of the ground is greater we use a solid iron bar. This plunger is forced to a desired depth, then cautiously withdrawn, and the well pipe is inserted. The lumen of the well pipe can be chemically sterilized in the laboratory, if desired; the plunger and the outside of the well pipe can be flame-sterilized in the field by use of a plumber's torch; thus, the well can be sunken bacteriologically sterile from air contamination. If by chance the screen becomes plugged, an automobile tire pump is attached at the upper end of the pipe and the screen is soon freed from obstruction.

To draw the samples, Crohurst has adapted an ordinary pitcher pump in the manner shown in the diagram. You will notice that the pump is screwed on a short blind pipe which serves to hold the priming water. This pipe is tapped by a one-eighth inch short lateral pipe, connected by a rubber hose with one of the two glass rods extending through the rubber stopper of a retort. The second glass tube of the retort is connected with a rubber hose to one of the two glass tubes perforating the rubber stopper of a sample bottle, and the second glass tube of this bottle carries at its end a small perforated rubber stopper. The latter is then fitted into the elbow of the pipette well after the screw plug has been removed. It is obvious that with proper precautions as to sterilization an absolutely noncontaminated specimen can be taken.

This device is proving of great value in our work, and it requires no special imagination to see that it can prove very useful in making temporary sample wells for various explorers and possibly wells for drinking water for some camping parties. It certainly opens up increased facilities in exploring ground water.

Larger pipette well: Mr. Crohurst's first important improvement on the pitcher well, from a standpoint of sampling ground water, is shown in Figure 4.

The wells consist of a 1¼-inch pipe, with strainer point on the end driven into ground water, similar to the ordinary driven well. On the top of the well pipe at the surface of the ground there is placed a 1¼-inch check valve, opening upward, above which is a length of 1¼-inch pipe 2 feet 8 inches long, capped at the top. This forms a reservoir above the valve. The cap at the top of the well is tapped and fitted with a one-eighth-inch nipple and elbow, into which a plug is screwed for protection between times of sampling. Just above the check valve in the riser pipe there is placed a one-eighth-inch brass stopcock, through which samples are drawn. Below the valve there is a one-eighth-inch nipple, elbow, and short straight length of pipe, the end of which is

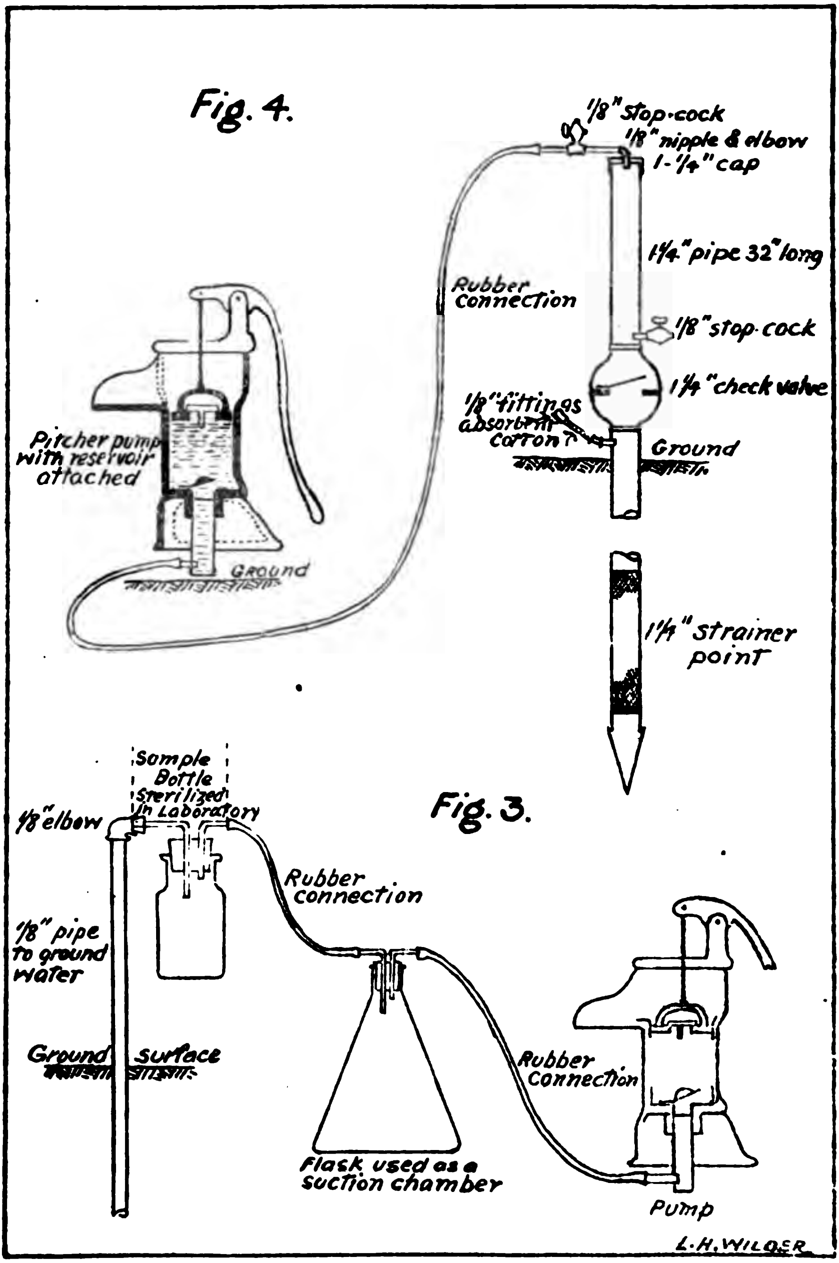


Fig. 4.

Fig. 3.

fitted with a valve to permit the water to fall back into the well to the water table after the sample has been taken. In the straight length of pipe absorbent cotton is placed, through which the air passes that enters the well.

In operation the plug in the one-eighth-inch elbow at the top of the pipe is placed in the coupling in the one-eighth-inch fitting below the valve. The suction of the pump shown in Figure 3 is screwed into the fitting at the top and the pump operated in the usual manner, which raises the ground water into the reservoir above the valve. The weight of the water above the valve closes the valve and holds the water in the reservoir. The sample is taken from the one-eighth-inch brass stopcock. After the sample is collected the plug is removed from the fitting below the valve, and this allows the water in the casing to fall back to the water table, and the plug is then placed in the fitting at the top of the pipe, after which the well is entirely closed until the next time for sampling.

Our pits and wells are at present arranged in 6 groups, and we expect to add 12 additional groups in the near future.

Group 100 is used for a pure typhoid experiment, to test out especially the viability of our cultures of *Bacillus typhosus* in competition with the subsoil and ground water bacteria in this particular soil. Unfortunately our finances do not permit us to subsidize a typhoid carrier, so that of necessity we must at present use pure cultures of typhoid.

Group 200 is used as control.

Group 300 represents a combined *B. coli* plus *B. typhosus* experiment.

Group 400 is used for special observations on the water-table changes.

Group 500 is used for a combined uranin and *B. coli* test, which has recently been started. In this experiment we expected to bury large quantities of uranin and of human feces directly into groundwater, but as a result of the reduction of the size of the Army most of the soldiers from whom we expected to draw our supply of excreta were sent away from the fort, so that we have been forced to use cow dung thinned with water, a substitution which in this particular test seems to be justified despite the fact that it is Hobson's choice. Prior to dosing, hundreds of examinations of the ground water and of the natural soil and subsoil had, according to Dr. Eaton, failed completely to show the presence of *B. coli* in the fields where we are working.

On the fifth day, after the first (April 25, 1922) dosing of the pit with diluted cow dung plus dissolved uranin, a rain resulted in raising the water table 3 inches, but up to this day (April 25) the result of the experiment was negative.

On the seventh day uranin was recovered from a well 12 inches away from the trench, while 20 other wells, all within 4 feet of the infected trench, were uranin negative, and all 21 wells were *B. coli* negative.

On the eighth day uranin was recovered from 6 wells up to 32 inches from the fecal trench; *B. coli* seemed to lag somewhat behind the uranin, but it was recovered from 4 of the 6 uranin positive wells and up to a distance of 24 inches from the trench.

On the ninth day—namely, after eight days' work—uranin was recovered in 9 wells spaced 12 to 48 inches from the trench, while 21 wells from 12 to 48 inches were uranin negative; 1 well, which had been uranin positive, but *B.coli* negative, on the seventh and eight days, and which is 32 inches from the trench, became *B. coli* positive on the ninth day, thus showing a lag of two days. Beginning with this day, wells which had been found both uranin and *B. coli* positive were not as a rule reexamined for *B. coli*.

From the tenth to the nineteenth day (May 13, 1922) no additional well became positive either for uranin or for *B. coli*, although one well (28 inches from the pit) which had shown positive for both uranin and *B. coli* became negative for *B. coli* while it still contained uranin.

Dry weather followed from the ninth to the twentieth day; progressive pollution could not be proved, but we awaited with interest the effects of the next rain.

On the seventeenth day events took a sudden and unexpected turn. The water samples were entirely negative beyond 4 feet from the trench, but a departure in the routine disclosed a small greenish spot in the capillary fringe above the water table 10 feet from the trench; a soil sample from this spot was washed in water and this proved positive for uranin. Borings were immediately made at various points and it was found that the uranin was present in the capillary fringe above the water table and outward away from the trench. On this (the seventeenth) day five soil samples from the capillary fringe were uranin positive; three of these were presumptive *B. coli* positive at 7½, 8, and 10 feet and two were presumptive *B. coli* negative at 10 and 11½ feet, respectively: four samples were both uranin and *B. coli* negative at 7½, 12½, 12½, and 15 feet, respectively; all of these samples were taken in the downhill direction from the pit. Confirmation reports on the *B. coli* presumptive are not yet in my hands.

On the eighteenth day two soil samples 1 and 2 feet, respectively, on the uphill side of the polluted trench were negative both for uranin and for *B. coli*.

On the nineteenth day three soil samples from the capillary fringe on the downhill side, and 6, 10, and 12 feet, respectively, away from the polluted trench were uranin positive, while four samples from the fringe 2, 4, 8, and 14 feet, respectively, downhill from the trench were uranin negative. Of the three uranin positive samples, two—namely, at 6 and 10 feet—gave presumptive positive test for *B. coli* within 24 hours, but the confirmation tests are not yet completed.

On the twenty-first day a soil sample from the capillary fringe 17 feet away from the trench was uranin positive, but the water layer below it was uranin negative, while a well 7½ feet from the trench was uranin positive.

The uranin band was approximately 2 inches thick, intensely green at some points, scarcely discernible at others, but easily brought out prominently in either of two ways, namely: First, by washing the sand in a bottle or test tube; second, by shaking the sand in a bottle the inside of which was slightly moistened with condensation water. The washing method is the better. At a time when the uranin was found in the capillary fringe 12 feet from the trench it could not be located in any of our wells more than 4 feet from the trench; up to this time *B. coli* was traced as far away from the trench as 32 inches in the wells, and according to the presumptive 24-hour test *B. coli* was present in the capillary fringe 10 feet away from the trench.

Possibly it is known to you that uranin appears in this way in the capillary fringe and can be found in the soil even when the ground-water examination is negative. It is, however, a new point for us and it opens up a number of very practical questions. We have had experiments in which our uranin has simply disappeared from view and has not been found later; we had one experiment in which the uranin was lost to view for nine months and then suddenly and unexpectedly appeared in our wells. We have been at a loss to know what had happened, but now the thought suggests itself that the uranin might have entered the capillary layer above the ground water and had later been washed down by a rise in the water table.

All sorts of theoretical questions arise; for instance, did this uranin actually travel laterally in the capillary fringe, or was it left up there by a decline of the ground-water table due to sudden evaporation and other factors, but not showing in our present water-table wells? In this latter event, why did the uranin not show in the ground water as far away from the trench as it did in the capillary fringe, or why was the green band only about 2 inches in depth?

Obviously the significance of these observations on the presence of uranin in the capillary fringe remains for the moment sub judice as applied to the spread of bacterial infection. We had not considered the capillary fringe (in comparison with the water table) as a practical factor in the lateral spread of infection, although we had considered it in connection with the vertical spread down to the water table. But it seems clear that the capillary fringe must be studied in connection with the problem of lateral spread.

One deduction of distinctly practical importance is justified from the results thus far obtained, namely, the point is absolutely beyond doubt or question that it is possible to obtain a negative uranin result in a well but a positive uranin result in the moist soil in the immediate vicinity, namely, in the capillary fringe, above the water table, within 3 inches of the negative well. The practical question now arises: How far can the capillary fringe carry uranin and bacterial infection from a point of pollution?

Again, our observations show that because of the irregularity and raggedness of the uranin movement (which resembles an irregular cloud rather than a uniform sheet) a given well can be negative because the uranin escapes it, but a positive uranin result may be obtained on the same day from a well 6 inches farther removed from the point where the uranin was inserted.

We are using the uranin at present only as a guide to show us where to take our water samples. It is altogether too early for us to generalize on the practical interrelation between uranin and bacteria. All I am willing to say at present is that in the early part of this experiment *B. coli* lagged some behind uranin, for instance, on the eighth day a well 32 inches away from our pit showed *B. coli* while a well 48 inches away showed uranin but not *B. coli;* and that indications are not entirely lacking that both infections had traveled diagonally rather than at right angles, therefore that the actual distance may have been greater than 32 and 48 inches, respectively. Further, a well which was uranin positive on the seventh day did not show *B. coli* until the eighth day; and a well which was uranin positive on the eighth day did not show *B. coli* until the ninth day; on the other hand, three wells which showed uranin positive on the eighth day confirmed as *B. coli* positive for the same day.

Group 600 is a repetition of the experiment of Group 500, but at date of writing we have had no rain since the dosing, and there is nothing at present to report, for all examinations have been negative.

It is becoming more and more obvious to us that our study demands a more intimate knowledge of the ground water with its many complicating factors, and on this account we have recently obtained the cooperation of the Ground Water Division of the United States Geological Survey in a study of our problems.

This subject of the water table appears to have been more or less prominent in the subconsciousness of the men who have been writing regulations for the construction and location of privies, but it seems clear that we know altogether too little about this factor in its influence on sanitation, while proof is present that even when there is a flow of ground water in a given direction negative results at a given spot are not a definite proof of negative conditions one or more feet away.

Despite the natural feeling of hopelessness which arises when we consider the theoretical possibilities as to the influences of ground water on the problems of excreta disposal, it would be well to recall that the rural districts of the country at large have unconsciously been making a nation-wide human experiment along this line and that typhoid has been showing a decrease instead of an increase. Further, in view of the increased knowledge of the past 15 years in respect to human "carriers" of typhoid, the thought lies near that our remaining and unaccounted for typhoid index can not possibly be attributed wholly, and perhaps not even in major part, to ground-water pollution. Despite this thought, however, it would be unwise to forget that we must prepare even for explosive outbreaks and the exceptions as well as for the rule.

B. VIABILITY OF PROTOZOAN CYSTS AND OF WORM EGGS.—From January 29 to March 5, 1920, we buried at Wilmington, N. C., under different conditions, especially in 17 sawdust pits, large quantities of human excreta containing spores of *Protozoa* (notably *Endamoeba* and *Giardia*) and eggs of parasitic worms, especially two kinds of thin-shelled eggs (hookworms and *Hymenolepis nana*) and two kinds of thick-shelled eggs (*Ascaris* and *Trichuris*).

The examinations made in May 1922, failed to show any recognizable spores either of *Endamoeba* or of *Giardia*, or any recognizable eggs or larvæ of hook worms (*Necator*). But recognizable eggs of *Hymenolepis*, *Ascaris*, and *Trichuris* are still present. Preference was shown to the smear method over the flotation technique, despite the fact that the latter is much less tedious. Not a single live egg of any of these three species of worms has been found, but patient and tedious search has revealed dead ova as follows *Ascaris*, 1,231; *Trichuris*, 40; and *Hymenolepis*, 5. In nearly all instances the degeneration of the protoplasm was extreme; in only one instance (an *Ascaris* egg) was it only slight.

Accordingly, present evidence is to the effect that under the climatic conditions that have obtained at Wilmington during the past two to two and one-fourth years, all traces of the spores of *Endamoeba* and *Giardia*, and of the eggs and larvæ of *Necator* have disappeared from the human excreta buried in 17 sawdust pits; further, that the eggs of *Ascaris*, of *Trichuris*, and of *Hymenolepis nana* have died. The thought naturally occurs to all of you that the fermentation in the excreta has been one of the chief factors, if not the chief factor, involved in this destruction of infectious material.

Bacteriological tests made of 17 samples of the buried excreta showed that *B. coli* was still alive.

PUBLICATION.—It has been the policy of the board to refrain from issuing bulletins, but there are some phases of the work in respect to which we have data that, it is felt, will be of use to you as matters of reference. Accordingly, the chairman is at present editing a bulletin which will be submitted to the bureau for publication. This will not contain final deductions in respect to all phases of the subject of excreta disposal, but will give you in available form certain data that have been of practical value to us and which we hope will be of use to you.

In summary, due to circumstances beyond our control, my report to you this year is less complete than I had hoped, but it is possible to present to you the following:

(1) Doctor Eaton has been using a tube rack which reduces tremendously the routine labor in laboratory tests on the *Bacillus coli* group, especially *B. typhosus*. This should result in a distinct economy in laboratories.

(2) Mr. Crohurst has developed two pipette wells which have revolutionized our method of taking water samples. The smaller pipette well, in particular, is destined to be of extensive use in a study of ground water, not only by us but also by others. It also comes into consideration as part of the equipment of exploring parties which may wish to safeguard their water supply and who are

traveling in a region where the water table is within reach of the air lift, namely, not more than 30 feet. It is inexpensive and practical.

(3) In a combined uranin and *Bacillus coli* experiment the extension of *B. coli* may lag behind that of the uranin, at least in some cases.

(4) Although a well shows a negative uranin result, the capillary fringe above the water table in the immediate vicinity, even within a few feet, may show a uranin positive result. It would therefore appear that in using the uranin test we must be prepared to modify the present generally used technique and take soil samples from the moist capillary fringe as well as water samples from the well, especially in case the latter is uranin negative.

(5) A given well may be uranin negative, but another well located a few inches away may be uranin positive. As tentative explanation of this fact we advance the point that uranin does not necessarily extend in a regular sheet, as one might suppose it would, but with a very irregular margin such as is seen in a cloud.

(6) Thus far we have assumed that the capillary fringe comes into consideration in the possible diffusion of infection vertically downward, but we have not been seriously impressed with it as a theoretical factor in lateral diffusion. Present indications are that the latter attitude may perhaps not be well founded, and at least that this point calls for study. Further, the theoretical thought presses itself forward whether or not the capillary fringe may not eventually prove to have a tendency to draw infection upward, thus presenting a tendency gradually to eliminate infection from the ground water.

(7) Sawdust pits in which was buried human feces containing protozoan cysts (*Endamoeba* and *Giardia*) and eggs of intestinal parasites (hookworms, *Ascaris*, *Trichuris*, and *Hymenolepis nana*) appear to have lost after two and one-fourth years all evidence of infection with *Endamoeba*, *Giardia*, and *Necator*, and all viable infection with *Ascaris*, *Trichuris*, and *Hymenolepis nana;* but samples from 17 pits all showed presumptive *Bacillus coli* the day I left the South.

(8) Mr. Crohurst has summarized the privy construction data, according to the regulations and official advice, as far as obtained, from the various administrative units of the United States, the Philippines, and Canada, and has prepared the engineering suggestions he feels justified in offering to you.

(9) The chairman is now editing a bulletin for presentation for publication. The manuscript contains data on construction, viability, disinfection, law, and economics, which we hope will be of practical use to you.

(10) Finally, we are looking forward with prayerful hope to the day when the new order of affairs in Government will have become sufficiently routined to permit work to proceed in a less interrupted way and when the Surgeon General will have a sufficient personnel on a permanent basis to render it humanly possible for him to keep men on their details sufficiently long to permit them to complete a job and to write up their notes. As respects finances, I have the honor to report that we have done our best to cooperate in every way with the present desire and demand to reduce Government expenses; we have succeeded in saving money, but this does not mean that the money saved represents an equivalent economy.

Doctor CUMMING. I think I noticed the chief of the ground-water section of the Geological Survey here a short time ago, and we would be glad to have him discuss Doctor Stiles's paper.

Mr. MEINZER. I have been greatly interested in listening to Professor Stiles's discussion, but am not prepared to say much.

Some years ago the water-resources branch of the Geological Survey was actively engaged on sanitary problems relating to water supplies, especially to the pollution of water by industrial waste, but since the Public Health Service took up that kind of work we have done little on the sanitary side of water supplies. We have investigated chiefly the occurrence, quantity, and mineral quality of the natural waters and their recovery and utilization.

Several weeks ago Professor Stiles came to the Geological Survey and explained what he was doing, and that was the first I had heard, so far as I remember, about this experiment. I at once became interested, because it has for a long time been felt that very little is actually known about how far bacteria will be carried in ground water. I went to Fort Caswell with Professor Stiles and spent several days on the geologic and hydrologic problems of the experiments in progress there. Since then Miss Dowell, one of the survey geologists, has been assigned to Fort Caswell for a month to help along the lines of hydrology. This action was taken because it was felt that if the results of this experiment are to have general application, it must be closely correlated with the geology and hydrology. I have great faith in the value of cooperation in scientific research. In nearly all of our ground-water work we cooperate with some Federal or State organization. I hope that this informal and very pleasant cooperation with the Public Health Service will be productive of some good.

The difficulty about the whole matter is that we are dealing with such exceedingly complicated conditions. If there were just one uniform set of conditions careful tests could be made and the problem could be definitely solved. But the rock formations are exceedingly complex and variable in texture and structure—even more so than appears to the eye. The sand at Fort Caswell, where these experiments have been going on, presents about as uniform conditions as will be found anywhere. Yet when the water percolates through this sand it moves, as Professor Stiles has said, like an amoeba, not because it has life but because it is much less uniform in texture and permeability than one would casually suppose. Not only the texture and structure but also the hydrologic conditions are complicated. The position and slope of the water table, and the intake, movement, and discharge of ground water are all of essential importance in this problem, but they differ from place to place and may change radically with the seasons or even with a single rainstorm. Hence, the results of a bacteriological experiment without precise observations on the geologic and hydrologic conditions can not be applicable in other areas.

The conditions at Fort Caswell are almost the worst conceivable for the movement of bacteria. The water-bearing material is a uniform sand, without any joints or fissures such as are common in the harder rocks. The water and anything that it carries has got to go through the comparatively small pores of the sand. There is, of course, plenty of sand that is finer than that at Fort Caswell, but if it is much finer you can not make a successful well in it. Hence, whatever results are obtained at Fort Caswell will be not average but nearly minimum results. If it is found that bacteria will be carried a certain distance under these conditions, we will, in general, have to apply a very large factor of safety.

This [indicating] is quite as much a surprise to me as to Professor Stiles. This band of green is several inches above the water table and above where the water table has been at any time since the experiment was started. It is puzzling to explain how the uranin has got past the test wells without being detected, and is found in the capillary fringe beyond the wells. The uranin has traveled in the direction that the water table slopes, and hence in the direction the ground water is moving. You will notice that no uranin has been found either in the ground water or in the capillary fringe on the upgrade side of the pit into which it was placed. It has traveled only in the direction that the ground water has been moving.

In this locality the water table is only 3 feet below the surface. Consequently, the water rising by capillarity will evaporate, and as it evaporates new water will be drawn up by capillarity to take its place, as kerosene is drawn up in a lighted lamp. Hence there is a constant upward movement of water through the capillary fringe. If you go to a place where the depth to the water table is 25 feet, the water will rise only a few feet by capillarity, according to the texture of the material, and will be a long ways from getting up to the surface where it could be evaporated. Consequently, the water in the capillary fringe above the water table will remain stagnant. It is quite likely that the green bands of uranin in the capillary fringe are due to the upward movement of the ground water and that where the depth to the water table is so great that there is no ground water discharged into the atmosphere the conditions are different. That question can be very easily put to the test.

The work that has been done by this board has, in my judgment, been exceedingly thorough and painstaking. No effort has been spared to make the results decisive and conclusive. Yet it seems that it will be necessary to make still more specific observations in order to corral the uranin and the bacteria effectively. As Professor Stiles pointed out, some of these wells were put down just to the water table and some to a level 1 foot below, some to a level 2 feet below, etc. They were put in almost every possible position to intercept the ground-water drainage. A very serious attempt was made to catch the uranin if any went by. Nevertheless, it got past those wells undetected and was later found in the capillary fringe farther on.

It seems to me that this experiment is very significant. It relates to a problem of great practical importance on which we have hitherto had very little satisfactory data. I admire and applaud the thoroughness and persistence with which the work is being done. I sincerely hope that the investigation can be carried on another year. or a few more years, if necessary, until the experiment is really completed and this difficult but intensely practical problem is as definitely solved as is possible.

Doctor CUMMING. I am sure that we all appreciate the discussion of this paper. I will tell you, as a matter of interest, that Doctor Stiles mentioned the amoeba in connection with dysentery. Some alarming reports came out 18 months ago about troops having brought an enormous amount of dysentery back. It came from an authoritative source; but, under Doctor Stiles, we have had thousands of specimens sent in and, fortunately, we can report negative results so far as we can find out. Doctor Stiles will make a final report on it before long.

Is there any discussion of this paper?

Doctor PIERCE. I would like to suggest that you extend the courtesy of the floor to Mrs. William Tilton for five minutes. She has some information in regard to the value of comparative data, and I am sure that it will be very interesting.

Doctor CUMMING. I am sure we will be glad to hear from Mrs. Tilton.

VALUE OF COMPARATIVE DATA.

Mrs. TILTON. According to records taken from 37 life insurance companies, the country was never so well as in 1921, and I believe seldom so good. We have made a survey of Massachusetts comparing the last two economic depressions, 1915 and 1921. The latter depression has been much worse in Massachusetts, and yet, even so, the decreases in 1921 over 1915 are marvelous.

	Per cent decrease.		Per cent decrease.
Total arrests	15	Deaths from Bright's disease	9
Arrests for drunkenness	43	Deaths from pneumonia	51
Penal population	51	Deaths from tuberculosis	23
Indoor relief	57	Suicides	9
Cases of nonsupport	18	Deaths from alcoholism	47
Deaths from cirrhosis of liver	47		

I wish we might get data like this sent to us from all the State boards of health of the country, with reasons why we have these decreases, as far as they can be gauged. We all want to help the health work of the country, and we can do it more intelligently if we constantly study what is happening through getting in reports and through trying to draw conclusions from the reports of just what is helping. We will send you a questionnaire, and I hope you will fill it out, and then we can publish it and send it through the women's organizations of the country that they may see what work is telling and be more eager to keep at the work and more intelligent as to what work to stress.

Doctor CUMMING. Doctor Creel will report on anthrax.

ANTHRAX.

Doctor CREEL. Mr. Chairman, ladies, and gentlemen, presumably ever since there has been anthrax infection among animals there have been associated with it human cases, more especially in certain groups brought in contact with these animals—drovers, stablemen, butchers, abattoir workers, and, in England, wool sorters. Formerly these cases had been regarded as clinical curiosities for the bacteriologist or the clinician to write about, but more recently the occurrence of human anthrax has become of human health interest and concern.

In 1916 the commissioner of health of the State of Massachusetts reported a series of some 20 or 25 cases of anthrax attributable to infection in a consignment of dry hides originating in Hankow, China. When you refer to Hankow or Hongkong or Canton you include several hundred square miles of China, because hides are merely assembled at those maritime ports. Previous to that time the Public Health Service did not give any administrative attention to the prevention of the introduction of anthrax, feeling that it was a subject adequately covered by regulations formulated in the Bureau of Animal Industry, Department of Agriculture, and issued as joint regulations by the Secretary of State and the Secretary of the Treasury. When these cases were reported, it became apparent that there was some defect in precautionary measures, either fundamental as to the technical regulations or some defect in their enforcement. A conference was held with the Bureau of Animal Industry, and it developed that the regulations contemplated that all hides from foreign ports should be covered by a certificate either to the effect that they had been disinfected or otherwise had come from a territory in which anthrax was not prevalent. There was one technical defect in the regulations, and that was the provision for disinfection for 30 minutes, one to one-thousandth bichloride solution, which was inefficient, and in addition to that it was the general practice that instead of immersing the hides they were sprinkled. The referred to consignment of hides from Hankow was accompanied by a certificate of disinfection. Even before that time the Bureau of Animal Industry had considered the revision of the regulation.

The Bureau of Animal Industry formulated and issued on January 1, 1917, new regulations, which appeared to be technically sufficient. I have a memorandum from the Chief of the Bureau of Animal Industry giving in detail the exact procedure as to the treatment of hides and measures for the prevention of the introduction of anthrax, so far as hides are concerned. I will read this memorandum and give you a better idea of what is being done.

(Doctor Creel thereupon read the memorandum referred to.)

That is the statement of Doctor Mohler, Chief of the Bureau of Animal Industry. There is no question about the necessity for the enforcement of appropriate precautionary measures. It is a question of where they should be applied. The foreign port of embarkation is where it should be done, but it will be frankly admitted that, so far as the Public Health Service is concerned, we would not be able to station at all the ports in the world inspectors to see that the work is done properly.

It is contended by tanners that unless the tannery process immediately follows the disinfection the leather quality is injured or destroyed; and this is agreed to by experts of the Bureau of Animal Industry. It means that if we attempt to enforce this disinfection at foreign ports 30 per cent of our leather supply would be diverted to other markets, and this would seriously disarrange the leather industry of the United States.

So far as the disinfection at the port of arrival is concerned (at the quarantine station), the same objection would apply as to injury to the hide, and the protection to persons in the United States would not be materially greater than if the disinfection were done at the tannery. The hides would be taken from the ship to the quarantine station and the handlers would be exposed. It seems that after thorough investigation the only practical solution is in disinfection of hides at the tannery, and the State authorities should cooperate in seeing that efficient disinfection be performed at the various tanneries. That applies to the anthrax situation as far as hides are involved.

There have been a large number of cases of anthrax due to infected shaving brushes. I have no figures as to the exact number.

I might also say, reverting to anthrax from hides, that a considerable percentage of cases reported during 1915, 1916, and 1917 were due to domestic infection. In 1915, out of 40 cases, practically none of them was attributed to imported infection, and of the 60 in 1916 only 25 in Massachusetts were due to imported infection. That is an additional reason why there should be disinfection at the tannery.

The shaving brush is an entirely different proposition, and when it became apparent that there were a number of cases occurring from the use of infected brushes imported from the Orient the foreign quarantine regulations were amended and also the interstate quarantine regulations.

The United States quarantine regulations were amended as follows:

Foreign quarantine regulations.

(126) Shaving brushes or lather brushes destined for shipment into the United States shall be made only from hair or bristles, known to be free from anthrax spores.

(127) Unless known to be free from anthrax spores such hair or bristles, before being made into shaving or lather brushes, shall be disinfected by one of the following methods: (*a*) By boiling for not less than 3 hours; (*b*) by exposure to steam under not less than 15 pounds gauge for not less than 30 minutes with a preliminary vacuum of at least 10 inches; (*c*) by exposure to streaming steam for not less than 6 hours.

(128) Consignments of shaving brushes of foreign manufacture shall be accompanied by a consular certificate containing a statement as to the prevalence or nonprevalence of anthrax in the territory from which the brushes emanate and also to the effect that the materials entering into the manufacture of the brushes have or have not complied with the requirements of these regulations.

Interstate quarantine regulations.

(14) No person, firm, or corporation shall offer for shipment in interstate traffic, and no common carrier shall accept for shipment or transport in interstate traffic, any shaving brush or lather brush unless manufactured in accordance with the following regulations:

(*a*) Shaving brushes or lather brushes shall be made only from hair or bristles known to be free from anthrax spores.

(*b*) Unless hair or bristles are known to be free from anthrax spores before such bristles are made up into shaving or lather brushes, their disinfection shall be accomplished by one of the following methods; (*a*) By boiling the hair or bristles for not less than 3 hours; (*b*) by exposing the hair or bristles to steam under not less than 15 pounds gauge pressure for no less than 30 minutes with preliminary vacuum of not less than 10 inches before turning on the steam; (*c*) by exposure to streaming steam for not less than 6 hours.

(*c*) All shaving or lather brushes shall be permanently marked with the name of the manufacturer or with a registered trade-mark in order to insure identification of the manufacturer and enforcement of these regulations.

It will be noted that so far as raw material in shaving brushes is concerned there is no restriction; the restriction applies only to fabricated articles. That provision was adopted because it was felt there was greater security in having the disinfection done in the factories in the United States than in foreign countries.

I might add that more recently there has been introduced a bill in Congress to prohibit the manufacture of shaving brushes from horsehair. It seems to be the consensus of opinion that practically all of these cases attributed to shaving brushes have been due to brushes made from horsehair, and if this legislation goes through it should remove the menace of the shaving brush; otherwise the only other practical way of preventing shaving-brush anthrax is to maintain thorough supervision of all the factories manufacturing shaving or lather brushes.

Doctor CUMMING. I want to state that this subject was taken up at the request of the State health office of Pennsylvania. Is there any discussion?

Doctor DALTON. We have a brush-manufacturing establishment, and when word came out to examine all these establishments for anthrax we sampled everything they had. We found they were receiving bristles and hairs from all over the world, and they were taking the added precaution of sterilizing all material before it was worked up. We sampled everything they had, and got no positive result, but we did discover this: In examining the sterilizing apparatus which they were using they were apparently not getting the results which they desired in the center of it when large quantities were used. We called attention to the fact that their sterilizing apparatus was not working satisfactorily, and they proceeded to fix that, so that when we went over it later on we found that they were getting results. The point I want to bring out is simply this: That because a particular manufacturer guarantees a sterilizing apparatus it is not fool proof, and it should be followed up in regard to this particular subject of anthrax.

Doctor CUMMING. Is there any further discussion? Is there discussion of the amendments to interstate regulations?

Doctor MCLAUGHLIN. I would like to say that we are getting along so nicely that we had better leave them alone. We had a lot of suggestions that should have been sent to the committee. There are three or four very good ones, but we had better not do anything at this meeting, in view of this fact, that the 18 States have put the sanitary code into effect, and I suggest that we leave them alone for another year.

Doctor CUMMING. Doctor Williams, of Virginia, wishes to make a statement.

Doctor WILLIAMS. We thought it would be of interest to the health officers to have the discussion in regard to rural health work take place where they have an organized health department. In Arlington County there is an organized health department. It was started a number of years ago in cooperation with the International Health Board, in which the International Health Board and the State paid half of the expenses, the county paying the other half. That lasted for about a year and a half, and then the county undertook to pay the bulk of the sum, and the United States Public Health Service helped us.

We have got in charge of that unit a man trained in the United States Public Health Service, Doctor Cox, who had charge of their work during the war.

As we know, the development in health work is largely due to length and breadth of one man, so the development of this work over there is chiefly due to the splendid work and influence of that health officer whom we were able to get from the Public Health Service. The continuance of this work and its development in recent years has been largely due to the influence and cooperation which sometimes we have been able to get from the Public Health Service, or through Doctor Lumsden's division and Doctor Cox's division. We hope that you will all go over there and see this work.

We have some moving pictures illustrating other features in health work that we want to show you, particularly some malaria work and rural sanitation, illustrated by moving pictures. The Public Health Service has kindly arranged to provide transportation. I think the county officials have given us the privilege of using the courthouse for the afternoon session. We will let the last automobile leave at 2 o'clock. I do not think it would be well for everybody to arrive at once. We want to see the health department office, and the first cars leave at 1.30 and the last leaves at 2 o'clock.

Doctor LUMSDEN. I think it will be very much better if Doctor Williams will let us go in a body, because the idea is, as I understand it, that Doctor Cox wishes to take only a short tour in the county, and show us certain features of the work, which will last three-quarters of an hour or an hour, before we assemble at the courthouse for the afternoon session, and it will be impossible to say which is the principal thing he wishes to point out. I think of one more thing that Doctor Williams did not mention. The Public Health Service did cooperate in it, and I am proud of the fact. We cooperated to a small extent.

Doctor CUMMING. The next papers are exceedingly important—the control of water supplies used in interstate traffic—and it seems to me that they should not be hurried. Is there anybody here who will discuss "Chlorine as a means of assuring the safety of drinking water"? I do not see how we will get through otherwise.

(Mr. Pincus then read his paper.)

CHLORINATION AS A MEANS OF INSURING THE SAFETY OF DRINKING WATER.

The subject of the chlorination of public water supplies is now a most important one for public-health officials to consider. So general and widespread has been the recognition and use of chlorine disinfection as a means of safeguarding public water supplies from becoming an agent for the spread of disease that it has become incumbent on administrative health officials to clarify and formulate their attitude or policy in the recommendation and use of this method of water supply protection. During the last 15 years about 3,000 public water supplies have had chlorination installed as a process for the protection of approximately 30,000,000 water consumers from water-borne disease, and in this same period the typhoid death rate, generally accepted as the best available index of the prevalence of water-borne disease, has been reduced over 60 per cent in the United States registration area. From the experience of so many places and situations where chlorination has been used and the knowledge and study of these results it is now proper, even necessary, that Federal and State health officials determine a deliberate and consistent policy toward chlorination—when it should be recommended, what it should be expected to accomplish, and what part chlorination should have in the general water supply protection program.

The question should be settled whether chlorination is to be looked on to-day as the panacea, the cure-all for dangers from water-borne disease, as it was first acclaimed, or if not, what its proper status is to be in the defense against infection through water supply.

It must be considered well established now that chlorination is not the all efficient, all-effective water purification process which some have looked for, nor is it ever likely to supplant or become a substitute for the older processes of water treatment. It is true that during the war on the battle fronts chlorine, or more properly hypochlorite, disinfection of water was the universal and generally sole means employed for purifying water, so that at the close of the war the chief sanitary officers of the armies of this and other countries held chlorination to have been the greatest single sanitary measure developed. But the circumstances in the armies under war time conditions are so unlike and opposite to normal and peace-time conditions of permanent communities that the former experiences and results are scarcely at all applicable. Chlorination can not properly and should not be looked upon as a complete method of protection to a community from a water supply that is receiving actual pollution. The situation regarding chlorination is somewhat similar to the pasteurization of milk, which is only one line of defense, a supplementary one, after other sanitary barriers against infection have been established.

Examining the chlorination process somewhat carefully, we find that it has certain special features peculiar to itself and to other methods of sterilization. Theoretically it can accomplish 100 per cent purification, i. e., can remove all infection from the most heavily polluted water given sufficient concentration of chlorine and length of contact period. Practically nothing like such a percentage of purification can be reached, even for very brief periods of time. Tastes and odors certain to result from high excessive doses of chlorine, limit the amount that can be applied. Then also the suspended matter in the water appears to have a protective effect against the action of chlorine, lowering the effectiveness of chlorination greatly. The varying chlorine demand of the organic matters in the water, which must first be satisfied before much bactericidal action is obtained, is one factor among many others that produce sudden and wide fluctuations in the continuous efficiency of chlorination. The difficulties at times of insuring the full delivery of the chlorine to the water and the thorough mixing with all the water are influences making for uncertain efficiency. Then, also, the unexpected stoppage of chlorine flow or mechanical breakdown, which may occur and go unnoticed for hours under the best waterworks supervision, during which times the efficiency of chlorine protection is simply zero, is a condition practically wholly peculiar to this process. With filtration or other methods of purification sudden breakdowns of plant are more quickly recognized, and even during such periods the purification remains effective to some extent. And then, above all other factors making the effectiveness of the process uncertain and irregular over long periods of time, is the exceedingly great dependence necessary upon the human factor inherent in the operation and control of chlorination. Though high technical skill is not needed, however, for anything approaching reliable performance, faithful and frequent attention, practically without possibilities of check by superiors, is required of the operator of the chlorination process. It is entirely beyond reason to expect that such routine, constant attention, day in and day out, year after year, can be expected from human agents. It is only necessary to refer to the experience in Milwaukee in 1916, where the night operator permitted the chlorinator to be shut down for only 8 hours, and in the next few days, 50,000 to 60,000 cases of enteritis occurred, followed in a fortnight by about 400 to 500 typhoid fever cases with over 40 deaths, or a similar experience in 1920 on a smaller scale at Pittsburg, Calif., where the chlorinator was off for one day, to show the unwisdom of placing such dependence for protection upon the human factor.

But if chlorination is not to be regarded as the complete treatment process for all kinds of unsafe or polluted waters it is not, on the other hand, to be felt that it has no large place in the program for water-supply protection. It is not my purpose to convey the impression that the chlorination of water supplies is to be looked at in all cases or the majority of cases with suspicion as to the safety and effective defensive barrier that it provides against water-borne infection. Nothing is farther from my thoughts. In fact, I fully believe that chlorination has been the greatest single factor to make possible the very high standards that exist to-day for water-supply quality, and in consequence the nearly vanishing typhoid-fever rates now prevalent in our communities.

What, then, is the proper place of chlorination in water-supply protection? In general, I believe the consensus of opinion of sanitary engineers would be that chlorination should be considered a supplemental safeguard, after other and more primary defenses have been established. It may be considered as a reserve line of defense, tremendously important, necessarily available for full effectiveness under sudden emergencies, but not the front and sole line of defense, where it would at all times have to be 100 per cent perfect under the full attack of the enemy. The function of chlorination as a permanent regular part of the purification processes should therefore be limited to acting as a finishing process or factor of safety after all other justifiable means of protecting the water supply and eliminating actual pollution have been efficiently provided. Though it should as a general rule be considered not the primary and sole protection, its great value and general use as a protecting barrier, wherever potential or even remote possibilities exist for unforeseeable contamination reaching the water supply, must be definitely acknowledged and accepted. If it is the aim of efficient present-day water-supply protection to remove every possibility of typhoid fever or other diseases being carried by the water supply, as far as reasonable expenditures permit, then unless a water supply is practically assured for an indefinite period against human pollution (and almost no surface supply whatever is so situated) chlorination should be employed. Wherever a state of irregularity, as Professor Whipple phrases it, is encountered in the quality of a water supply, no matter for how infrequent occasions, there is possible danger and the effective, economical safeguard of chlorination should be used.

Before concluding my discussion on chlorination there is just a word I wish to say about the control of the process. Chlorination without control—control of dosage, analytical control of quality of the treated water, and control over operation—is practically worthless as a barrier against water-borne infection. When first advocated, the importance, extent, and requirements for the control of the chlorination process were not well understood nor emphasized to any extent. Because of this fact there are very many chlorination installation to-day that are giving questionable protection to the communities whom they were installed to safeguard. To-day these features of control in chlorination are tremendously emphasized and are considered of the utmost importance. The dosages of chlorine are made to vary with the particular daily variation in the organic matter in the water and with the bacteriological analyses, the rate regularly being controlled by the excess chlorine test. The chlorine feeding apparatus is given careful, frequent inspections several times daily by conscientious, faithful employees. And finally, the total efficiency of the process is checked daily by the results of bacteriological examinations of the chlorinated water. With such control chlorination, if properly used as a supplemental process in eliminating actual pollution or as a precautionary safeguard against potential dangers, will be found to be one of the most reliable and efficient means science has ever devised for the protection of the health and well-being of mankind.

Doctor CUMMING. Is there any discussion about Mr. Pincus's paper? If not, we will stand adjourned for luncheon, it being understood that the automobiles will be here from half past 1 o'clock until 2 o'clock, and we will go to Arlington.

(Whereupon an adjournment was taken.)

AFTERNOON SESSION, MAY 17, 1922.

(The conference reconvened in Arlington County courthouse at 4.30 o'clock p. m.)

Doctor CUMMING. I think most of the State health officers are here.

The first thing on the program, I think, is Doctor Rankin's report on rural health work. When they hear Doctor Rankin talking, I know the rest will come in. This is a very important report, and I feel that we shall all be interested.

RURAL HEALTH WORK.

Doctor RANKIN. The report of the committee on rural sanitation for this year simply returns to the position this committee has taken for the past two years, and which you have indorsed, which is briefly that the conference recognizes the problems of rural sanitation as problems involving joint responsibility by the Government of the American people, National, State, and county. The second principle which you have indorsed with respect to dealing with the problems of rural sanitation is that of stimulating State activity through national subsidy. The committee has nothing to add that would in any way change the principles upon which you have acted already.

I thought it might be interesting to you to point out very briefly a principle upon which we have been working in North Carolina and which I have referred to in discussing the subject of rural sanitation once or twice before. In some 10 years experience in the development of local health departments, we have found that the adjustment of central or State influence to the development of local interest and responsibility was perhaps the most difficult problem we had to deal with. We have felt that it was necessary to exercise some stimulating influence in the development of county health work, and at the same time we have recognized the danger of going too far with that sort of an influence, going so far that it inhibited or prevented the proper growth of local interest and responsibility. You can not impose salvation, spiritual or physical, upon the people. That is the most difficult problem we have had to deal with. We first tried exercising a good deal of local influence by saying who the county health officers should be. Forty per cent of new health officers drop out in the first two years. Wherever we have been too closely identified with the selection of a local health officer, we have had the responsibility for his failure passed back to us. People have complained to county authorities, and they have said the State board of health sent them down here, and we took them on their recommendation, and the board slipped up, and so have "passed the buck."

Another thing we tried was to formulate a plan for the local health officer and so exercise influence in local work, and by going too far in that direction we have gotten into trouble again. Wherever there has been trouble and failure we are held responsible, because local authorities, when complained to, have said the health officers had to carry out the plans of the State board of health. The problem has been to exercise a directing influence rather than control, and at the same time develop local interest and local responsibility. In bringing that about we have endeavored to reduce local health work to a cost basis.

Those of you who heard the last speaker will remember that Doctor Draper said that in the last five months the picture which he exhibited was shown 105 times to 18,000 people, and the average cost of showing the picture to each individual was 7.2 cents. He has reduced, or at least can reduce, that sort of work to a cost work basis.

We have attempted in North Carolina to reduce every item of work that the local health officer performs to a cost basis. Please make the important distinction in your mind between costs and values. I am not talking about health values. I am not talking about the value of vaccinating against typhoid fever. I am talking about what it cost to do that thing.

A form of report in use in North Carolina shows the health work agreed upon by the State board of health and the local health officers—some 70 or 80 items. It is not supposed that each county health officer can do the whole of it. At the end of the month he will report in the second column on this blank form [indicating] the number of each item of work which he has successfully accomplished. Just to illustrate how the plan works, take the item on typhoid vaccination. There is an established value of 50 cents for each vaccination. That is more than it costs to vaccinate people, but that is the cost value permitted here. Suppose the health officer in a certain county has vaccinated 200 people during the month; he puts that in the second column, and in the third column that would have a total cost equivalent of $100. Every item is worked out on the same basis, so that when the local officer sends this report in at the end of the month you can turn over to the last page and find out the total expenditure in that county during the month. Suppose he spent $600 and suppose his total value is $600, then by dividing the total cost equivalent you get his earnings on the dollar expended, namely, $1. Suppose, on the other hand, that the total cost value was $1,200; then he had earned $2 on every dollar expended. This permits us to reduce the health work of the counties to a common denominator, which the ordinary layman understands.

A man may be working in a county that has 70,000 people in it, and he may have a budget of $25,000. Take the total amount of money spent each month and divide the total cost equivalent and you get what he earned on the dollar. Another man may work in a county of 12,000 people on a total budget of $5,000. Take his total earnings, divide by his total expenses, and get his earnings per dollar expended. In this way you get the comparative efficiency of the man whether he be at work in a large or a small county. It does not make any difference what sort of work he is doing. One may be doing trachoma work and another venereal-disease work. Another man may be doing malaria and typhoid vaccination and medical-inspection work. You reduce the work of both counties to a cost value in terms of the dollar and can make a comparison between the counties irrespective of their size and population and irrespective of the kind of health work which is being carried on.

Our State, like a great many other States, subsidizes local health work. We pay a man so much money a year—$2,500 a year. Instead of conditioning our payment of State funds to the county upon their getting a health officer, upon their adopting a plan which we may or may not approve, we condition the State subsidy on his earning capacity, not upon prospective service he is supposed to render but upon service rendered.

Here is the way the plan works out: If a man earns a dollar on a dollar expended, we pay him $200 a month. We are paying $2,400 a year. Suppose instead of earning $1 on the dollar expended he earns 80 per cent. He would get 80 per cent of $200, or $160 per month.

In this way the State is paying over the money to the county and is absolutely protected against inefficiency. If a man does not earn a dollar for the dollar expended, to that extent he loses State funds. You can guarantee the appropriation committee of your legislature that their money will not be spent for prospective service but only for service that has been rendered.

You may be interested in seeing how this works out. Here are 24 counties that have been tabulated for three months. You will see all the items over there in the first column [indicating], the names of the counties at the top, and you can turn to the bottom of the last row of figures, which gives the earning capacity of each county on the dollar expended. These 24 counties during the last three months expended $47,432.59. They have done $69,234 worth of health work and earned $1.44 on the dollar expended. Looking at the amount of earnings by each individual county, you will see that one county earned $1.22, the next $2.23, the next $2.09, another $1.12, another $1.28, another $1.57, and another $1.01. There are two counties earning only 81 cents on the dollar and one earning only 69 cents on the dollar expended.

One more point and I am through. The question may be raised as to whether the value of the individual items of work are too high or too low. It does not make any difference whether you are dealing with an inflated or deflated currency. In either event you have a standard of measurement—the average earning on the dollar expended. If the health officer falls down in his earning capacity the people will not keep him. He has to earn his money.

Any questions? If so, I shall be very glad to try to answer them.

Doctor STILES. How about your bookkeeping?

Doctor RANKIN. It is a very simple matter. I am glad Doctor Stiles brought that up, because a system of records is necessary in this sort of thing. We have here a little card which is just the size of an ordinary index card which fits in a file case, and if the man has, for example, a case of vaccination, he writes the name, race, etc., and checks typhoid vaccination, or whatever it may be, and that is dropped in his typhoid vaccination folder. It takes him two or three seconds to make out the card.

The understanding with the health officers is that we shall take 200 of these cards and check his records. Ninety-six to ninety-eight per cent of the men are honest, but we have to protect ourselves against an occasional dishonest man.

Doctor STILES. Who audits them?

Doctor RANKIN. The State board of health audits them. We take out 200 cards a year. That is our regulation. If you go before an appropriation committee and tell them that money is needed, and the legislator says, "How do you know," you can give the name and the address, and the place where all the work is done, for example, a privy being built, or what not. There is enough to verify the work.

Doctor **Garrison**. You base the salary of the local health officer on the results he gets?

Doctor **Rankin**. Yes.

Doctor **Garrison**. What is the average salary?

Doctor **Garrison**. The salaries vary from $2,700 to $4,500, and $600 additional for travel.

A **Member**. What do you mean by results?

Doctor **Rankin**. His earning capacity on the dollar expended.

Doctor **Cumming**. Is there any discussion about Doctor Rankin's paper? Unless there is some objection, it seems to me it will be well worth while, inasmuch as we are out in the country, to clear up the rural health work.

Doctor **Welch**. Let Doctor Lumsden read his paper and discuss them together.

Doctor **Lumsden**. I shall not undertake a comprehensive discussion of Doctor Rankin's paper. The evaluation system which is being tried out in North Carolina is exceedingly interesting and may prove in practice to be of value in the administration generally of cooperative health work. From my present limited knowledge of the details of the system it seems to me to present some definite advantages and some definite disadvantages.

In the course of a fairly extensive and intensive study of rural health activities I have become more and more impressed with the importance of clear perspective in local health work. The most important constant concern of the local health officer should be not what may count most in some evaluation system when recorded on a sheet of paper but what his department can do with the resources available and under the local conditions obtaining which will do most for the prevention of disease and the promotion of health. I can conceive that a local health officer with clear perspective might concentrate for a period of weeks or months his activities along lines which would make little or no showing in some elaborate evaluation system but by so doing lay a solid foundation for big constructive, lasting work, while another, with clouded perspective, might take short cuts to transient success on paper and accomplish little or nothing of lasting benefit to his community.

The program of health work in Arlington County, Va., of which we have had a somewhat sketchy view this afternoon, could not have been carried to its present degree of success, or to any degree of success, if the county health officer had not given a large proportion of his time for a period of about six months to cases in court. Without the work in court the whole program of health activities would have been terminated, but that work in court probably would not have counted as "results" in some of the evaluation systems proposed.

I shall review briefly now the health work in this county. The work was begun in August, 1919, as a cooperative project in which the county authorities, the local Red Cross chapter, the State board of health, the United States Public Health Service, and the International Health Board participated.

The funds provided the first year for the support of this demonstration in rural health work totaled $8,000, of which $4,000 was appropriated by the county government. The appropriation by the county government for the second year of the work was $12,000. The budget for the third (the present) year is about $24,000, of which about $21,700 is provided by the county and $2,300 is allotted from the rural-sanitation fund of the Public Health Service. The funds available now amount to about $1.25 per capita of population, which is the largest I know of for the support of health work in a strictly rural community, and is sufficient for a comprehensive, effective program of health activities under these local conditions.

From the beginning of the work the county health officer has endeavored—as all health officers should—to carry out in logical sequence the different branches of health work needed and feasible—one activity following and dovetailing with another without increasing overhead expense.

Among the first activities concentrated upon by the county health department was the control of soil pollution. You have observed that the county is thickly built up. The area is only 28 square miles and the population is about 19,000. There was no public sewerage system nor public water supply. At a large majority of the dwellings in 1919 open surface, grossly insanitary privies were in use. Typhoid fever, dysentery, and worm infections were prevalent. Under good business management and with remarkable rapidity, box-and-can sanitary privies, septic tanks, and water-tight sewage tanks were installed and a public scavenger service inaugurated. Of the 3,800 dwellings in the county, about 2,000 have been equipped with box-and-can sanitary privies and about 1,600 with either septic tanks, with subsoil disposal of effluent, or with water-tight sewage tanks from which the sewage is pumped. The public scavenger service is more than self-supporting by a margin of profit of over $10,000 annually.

The next activity concentrated upon by the health department was the physical examination of school children and the carrying out of a system of follow-up visits, health games, and general educational measures to secure correction of physical defects found. Health clubs were formed in the school. The general health club of each school competed with the general health clubs of the other schools. Each grade in the school has a health club to compete with those of the other grades in the same school, and in each grade there are a boys' club and a girls' club which compete with each other. As a result of the competition system for health standing, the degree of well-directed enthusiasm for health among the school children of this county is most remarkable. Over 80 per cent of the physical defects found on the first round of examination have been corrected. In three of the larger schools a record of 100 per cent corrections of corrigible physical defects has been made. In none of those three schools can a decayed tooth be found. Think of it! Enlarged or diseased tonsils, adenoids, and marked malnutrition now are unfashionable and are viewed with derision by the membership of the school health clubs. A dentist on the county health department force works all day every day fixing the teeth of and teaching mouth hygiene to the school children. Tonsil and adenoid operations are obtained under contract at a cost of $15 a case at the near-by city hospitals. In each grade in each school there are a boy health officer and a girl health officer. They definitely understand that they are members of the working force of the county health department, of the State board of health, and of the United States Public Health Service. They perform their duties with a zeal and diligence which make some of us older ones feel like back numbers and realize that great are the wonders of democracy.

From the beginning of the work measures to prevent the spread of infection from cases of acute communicable disease have been carried out as rigidly as practicable and invariably have been given priority over other activities of the health department.

In this, the third, year of the work special activities for the promotion of infant and maternity and preschool child hygiene, adult life extension, and tuberculosis control have been well started. At the two baby clinics over 250 babies were examined in the first month of that special activity.

At our annual conferences for some years past I have endeavored to emphasize the advantages of well-balanced, effective, economical, and comprehensive local health service performed under the direction of one whole-time local health officer, so as to have a maximum of work with a minimum of overhead expense.

This work in Arlington County appears to me to demonstrate well the fundamental advantages of such direction of all branches of health work in rural districts. Every public health activity here is carried out under one administrative head. It is a job with a man on the job who knows it. The health nurse engaged especially on infant hygiene work or on school hygiene work may be assigned to other duties from time to time, as the health officer at the head of the unit deems advisable. With all members of the force under one administrative direction, there is at least a chance for economy and efficiency in the public health business. So much for Arlington County.

I have just completed the tabulation of the returns from the State health department on the progress of whole-time local health service in our rural districts during the calendar year 1921. It is exceedingly gratifying to me, and I am sure it will be so to you, to know that in 1921, which was a year of general economic depression, the number of counties or equivalent divisions wholly or in large part rural provided with local health service under the direction of whole-time local (county or district) health officers was increased from 161 to 203, a gain of 42. I think that all of us who have preached and prayed and worked and fought for the common-sense principle of reasonably adequate local public health service under the direction of duly qualified whole-time local health officers should be encouraged from the report of progress in 1921 to hope with reason for great results in this vitally important field within the next decade.

We who from study and experience know something of the administrative principles involved in rural health work should avoid advocating makeshifts which, though at times perhaps offering temporary gains, will result in permanent loss. We should hold to our faith and express that faith with both words and work. If we do not, we shall not do our full duty to those we serve.

Doctor CUMMING. Is there any discussion of this excellent report? To my mind these have been exceedingly important reports.

We do not want to discriminate, but Doctor Park is coming down from New York to-morrow, and has to go back. His paper is a very important one.

If it is not imposing on you too much, I would suggest that we meet at 9.30. I would like to have some expressions of opinion. Suppose we have a motion.

Doctor MCCORMACK. I move that we meet at 9 o'clock.

(The motion was duly seconded and carried.)

Doctor CUMMING. We will meet at 9 o'clock to-morrow morning at the Red Cross Auditorium.

(Whereupon, at 5.15 o'clock p. m., the conference adjourned until May 18, 1922, to meet in the auditorium of the Red Cross Building at 9 o'clock a. m.)

MORNING SESSION, THURSDAY, MAY 18, 1922.

(The conference met at 9 o'clock a. m.)

Doctor CUMMING. The conference will please come to order.

The Public Health Service, as you know, functions under the Treasury Department, and we are fortunate in having with us the

Assistant Secretary of the Treasury, who takes a very active interest in the welfare of the service. Colonel Clifford has been good enough to come here this morning, and will address you, and I take pleasure in introducing Mr. Edward Clifford, Assistant Secretary of the Treasury.

Mr. CLIFFORD. It is related that when Mark Twain was taken to the White House to be presented to President Grant, after the introduction, the President, who had a cigar in his hand, put it in his mouth and began to smoke it. Mark also pulled out a cigar, put it in his mouth, and looked at General Grant. The President then removed his cigar for a moment, replaced it, looked at Mark, and again began to smoke. Mark Twain did likewise, and continued looking at the President. The third time that the President put his cigar in his mouth without saying anything, Mark could not stand the silence any longer; so he shifted his position and said, "Mr. P-P-President, I am em-em-embarrassed. Are you?"

That is the way I feel this morning. As I have said to the Surgeon General, I do not understand why a banker was selected to supervise the United States Public Health Service, but it may be that in shifting the political cards here I got the job which was intended for Dr. Hubert Work, who is now Postmaster General.

However, I am glad to be here this morning, and on behalf of the Treasury, welcome you to this conference. I think we have an efficient United States Public Health Service. As all of you gentlemen know, it has been put to the test during the last three years in caring for the sick and disabled World War veterans, and has not been found wanting. I am not going into that subject except to say that the work was thrown on the United States Public Health Service in March, 1919, without any warning. From that time up until the 1st of May, 1922, when the veterans' hospitals were transferred to the Veterans' Bureau, it gave treatment to over 200,000 disabled World War veterans. There is no question in my mind but that the whole country realizes, more than ever before, the enormity of the task performed by the United States Public Health Service, and I think it will go down in the history of that service, which has been functioning since 1798, as a notable achievement. Now that this problem has been rightfully lifted from its shoulders, I think we may expect much greater things in the regular public-health work.

It seems to me that the United States Public Health Service has two main functions. One is to prevent contagious diseases entering the country through the immigrant and to guard against the interstate spread of disease. It can not be expected that this work will be done by the State or local authorities. This national work will be done just as efficiently as Congress will permit the service to do it. For the United States Public Health Service can function only along the lines for which Congress appropriates the money. I trust and believe that Congress will be fair in the matter of appropriations and that the service will have adequate funds to continue that work and bring it up to an even higher standard; in fact, it should do better than during the past three years now that it does not have the responsibility of caring for the veterans of the World War.

I am one of those who believe that the National Government should never do anything which private individuals or local governments can do. You will see that I am opposed to Government ownership of any kind.. I am opposed to the National Government usurping any of the powers which should be exercised by the individual or by the State or local governments. That does not mean that I am not in favor of regulation. I believe in private ownership with strict regulation. The initiative of the individual must not be killed. The best service will be rendered to the people of the country where individual initiative is unhindered.

If you read the history of our Government and how it was formed, you know how jealous the 13 colonies were in giving any powers to the National Government. They only gave the United States certain powers and retained all the others themselves. Now, because the Federal Government has functioned rather well and has the enormous resources of the National Treasury back of it, there has been a growing habit on the part of a great many people of this country to run to Washington every time a vexatious problem is presented to them. The result is that there has grown up a strong central Federal Government, which has been gradually closing upon State and local governments in performing local functions.

I think we have gone entirely too far in centralized government, and I think it is time that the people of the country take account of stock, so to speak, to see just where we are drifting. I believe the more thoughtful ones will conclude that we are putting too much of the burden on the National Government and making it do too much of what the States and municipalities ought to do.

I will go so far as to say that I am opposed to the spending of money from the National Treasury in the various States where the only benefit is to the local residents. I am strongly of the feeling that we should be jealous of our local rights, and not let the National Government, just because certain people think it can function better than the local authorities, come in and try to regulate us and do all the police work which we should do ourselves. Therefore, the second function, it seems to me, of the United States Public Health Service, and I know that this is the feeling of the Surgeon General and of his associates, is to be an aid to the local government in solving their local health problems.

On account of the experience and the facilities which the National Public Health Service has, it should do the investigating and the laboratory work and should coordinate all the work which is being done in the various States, and should be a sort of central agency of suggestions, if I might put it that way, to which the local health people may come to get the concentrated ideas of all the men who are doing public-health work. That is the thought the United States Public Health Service has; that you may meet under a central agency which has the machinery to gather together and, to use the word so popular in Washington at the present time, "coordinate" public-health thoughts and the public-health investigations and tabulate the results, so that they may be of benefit to all.

I think the local health problem in Evanston, Ill., where I live, is a matter for the Evanston people to attend to, and we should have a strong public health service there. I think we have. However, the inspiration should come from the Public Health Service in Washington, through the Illinois Board of Health, so that our local health service can have the best thoughts and ideas and get the best results from the investigation that the National Government is making and apply it to our local problems. As a citizen of Evanston, I would resent having a national public health man coming to Evanston and telling us what to do, unless at our request. I am sure under this administration there is no thought of the officers of the United States Public Health Service going to any community and endeavoring to dictate as to the handling of its public-health problems, although we are called upon to do that a great many times.

A college classmate of mine in a distant State recently thought that the health conditions in his town were bad, so he wired me to send a United States Public Health specialist to his town to make an investigation and tell the local physicians what to do. I replied that we would be very glad to cooperate with the physicians in his community upon the request of the board of health of his State; that if his local physicians would put the problem before the State board of health and that board felt that they needed some advice and suggestions from the specialists of the United States Public Health Service in Washington these specialists would gladly be sent. That is the idea I have of the position which the Federal Public Health Service should take on questions of this kind.

We have a hygienic laboratory here where we should make all the investigations we possibly can and give the results to you public-health men from the various States. We should take the literature relative to public-health work which any of you men get out and have it put in permanent shape for distribution to those of you from other States, and we should have frequent conferences, not only national but conferences in the various States. We should furnish specialists on public-health problems to come to your State and address the conferences. When you have particular problems for investigation we should have our national public-health men go to your States, upon your requests, and help you make these investigations and cooperate with you in making your States healthful communities. We want to give you all the practical assistance that we can.

I realize in doing this that the Surgeon General must send out physicians who are men of tact; that they must not be getting in where they are not wanted, and when they do go into your States they must conduct themselves so that there will not be a feeling on the part of the local people that the Federal Government is usurping the States' powers. I recently heard a speaker describe the difference between courtesy and tact. He said a master plumber in Philadelphia was instructing his workmen who went about fixing bathrooms. He told them they must be both courteous and tactful. He said, "If you step into a bathroom and find a lady taking a bath, as you back out of the room you should say, 'Excuse me, madam,' that would be courteous; but if you should say, 'Excuse me, sir,' that would be tactful."

As I said at the beginning, I do not know that there is anything I can say to you gentlemen except to tell you this, on the part of the administration and the Treasury. We are very glad, indeed, that we have such a splendid lot of men and women who have taken up the health problem throughout the country. I say "splendid" men and women because in the year that I have had supervision of the Public Health Service I know what you are doing. I know that there is a lot of hard work and no particular glory in it for you, and not very much money; but if this country is to function properly and not degenerate, we have got to have the interest of high-class men and women in public affairs. Most people, of course, are selfish. We shall never attain the highest plane of civilization in this country if there are not in every community some people who are unselfish and who will do their part for the public good. There are a great many reformers that do not reform very much. They get in the stream and muddle it up, and somebody who thinks straight comes along and steers the proper course.

I find through my supervision of the Public Health Service that the physicians of this country are usually men who think straight. Some one said about you, in paying a compliment to the physicians of the country, that medicine is the only decent profession for a gentleman; but he said you all work hard, live well, and usually die poor. The physicians of the country can do more good by guiding the people along right living, not only physically but morally and mentally, than anyone else. I am delighted to know that we have so many upstanding men and women who are grappling with these problems all over the United States. Anyone who travels knows how far ahead we are in sanitation and public health compared with other countries, and I think it is due to the fact that there is something about your corps—you physicians and sanitarians of this country—some sense of responsibility to our Government and to our people.

It is fortunate that we have such a lot of public-spirited citizens who are thinking of what they can do for their fellow men and who are spending a good part of their time for the public good.

You State public health officers and sanitarians are doing a wonderful work, and the Treasury, through its Public Health Service, wants to encourage you. You can count on this bureau, with Surgeon General Cumming at the head of it, to do its part in cooperating with you in every way possible. Of course, you must not expect that we can solve all the problems that come up, but we will do our best. We do not expect to come into your field and do your work for you, but we do want to be here with a strong, central, expert, scientific organization which, with your cooperation, will endeavor to solve the public health problems as they come up and make the United States the healthiest place in the world.

I hope that you will feel free to come to see us and to write us and that you will send us the results of your investigations, so that we may have the benefit of your advice and suggestions and cooperate with you in every way.

I thank you for giving me the opportunity of welcoming you on behalf of the Treasury.

Doctor WELCH. The president of the conference, on behalf of the conference, I wish would thank the gentleman for his good American talk. I do not think there is a man in this audience that can't respond most heartily to everything he says and thank him for the angle of view which he tells us that the administration at Washington has. Irrespective of parties, we have all felt in the last quarter of a century that we were tending too much to centralization, and as a representative of the rural districts of this country I wish to thank the Assistant Secretary for what he said this morning in behalf of the conference.

Doctor CUMMING. I am sure we all appreciate very much the Assistant Secretary's coming here this morning, because he has a great deal of work, and he asked me to tell you that he had a definite engagement with the Speaker of the House of Representatives and asked to be excused.

The program was slightly disarranged, as you know, yesterday afternoon, but we will continue here. Doctor Frost is not here. The next paper is " Cooperative certification procedure," a matter of considerable importance, and I will ask Mr. Emerson, State engineer of Pennsylvania, to speak. It is a matter in which we are very much interested.

COOPERATIVE CERTIFICATION PROCEDURE.

Mr. **Emerson**. Mr. chairman and gentlemen, it has been said by some that the amount of time devoted to the certification of water supply for interstate carriers is out of all proportion to the public health benefits derived from this work. A statement such as this should be carefully investigated and I would like the opportunity of offering a few points for your consideration in future discussions on this subject.

At the present time the railroads of our country are taking water supplies for use of passengers from some three thousand different points. Many of these are privately owned supplies, and if it were not for this certification there would be no public health supervision over such supplies. In numerous other instances—even though the supply is also furnished the public in municipalities—the laws of the State are such that the health authorities would be unable to issue orders for sanitary improvement and the power delegated through the cooperation of the Federal Public Health Service is about their only method of bringing these supplies to the desired standard.

To some of you this will mean little, but to others, and particularly the executives of the State where the majority of railroad watering points are privately owned or where the laws respecting purity of water supplies gives the State health organization but little power, this statement should mean a great deal.

Another feature now being given attention is the method of handling the water supply on trains. You, of course, appreciate the opportunities for contamination of a pure supply through careless or ignorant yard gangs and train crews. The undesirable conditions obtaining in the past are being rapidly corrected.

There is an impression from some quarters that this whole policy is in a nebulous state. This is hardly fair, either to the Public Health Service or to the engineers of the various States who are doing the field work. Last year a report was made to the Surgeon General by a committee of sanitary engineers, and this report was approved by your organization. Certain recommendations for modification of the certification method then being used were promptly adopted by the Surgeon General's office, and after almost a year's trial of this modified procedure I have within the past two days been informed by a number of the engineers here in conference that no further modifications of any moment are necessary at the present time, as the whole project is working so well.

The Public Health Service has asked for the opinion of the engineers as to the proposed modification of interstate quarantine regulations respecting the discharge of sewage in the vicinity of waterworks intakes. The engineers' conference has considered this carefully and has instructed me to report to you that, should the Public Health Service bring this clause up for amendment, the engineers favor it.

Another point which, I believe, should appeal to the State health executives is the mere fact that a report must be made to the Federal Government each year on the quality of water supply taken from the public mains by the railroad companies is a great incentive to your engineering force, for it constitutes a check on the extent of their water-control work throughout the State. It is conceivable that this examination for railroad purposes may also serve to bring to light dangerous conditions affecting the citizens of the municipality using this same water in their homes. In fact, I know that such has been the case. Is it, therefore, fair to charge against railroad certification all of the expense of the inspections and analyses? Should not a large percentage of this expense be charged against general inspection work?

Inasmuch as all but two States in the Union are now preparing these certificates for the Federal Government, and as most of the work for preparing them falls upon the engineering divisions of the various States, I believe you will welcome the assurance of the engineers' conference that the matter is of considerable importance to them and a procedure from which they derive benefit.

Doctor CUMMING. Is there any discussion of Mr. Emerson's paper?

Doctor WELCH. I would like to add my word of indorsement to the policy of municipal water control, brought about by this certification of water. There was one town in Alabama where we had not been able to induce the authorities to do anything toward the purification of the water. We had notified them several times that they must do certain things, but they only laughed at us. I asked permission of the Surgeon General to post the water. I notified the physicians of the two railroads going through that town that they must post in the railway station a notice that the water supply was unfit for human consumption. The plant was put in satisfactory condition in a short time.

The same condition obtained in another water supply in the northern part of the State, and as soon as the chamber of commerce found out that we would post the water supply they immediately got busy.

I should be very sorry, indeed, to lose this whip. The State Board of Health of Alabama will assume all responsibility, but we do want the privilege of demanding of the railroads that they post these water supplies when we order it.

We have not had any trouble with them so far.

Doctor CUMMING. I will ask Doctor Beatty, of Utah, what the procedure is in his State.

Doctor BEATTY. It has been a valuable agency in assisting us to improve the water supplies in various localities where our efforts had proved unavailing. In many instances communities are willing to tolerate contaminated water supplies as long as it can be done without the publicity which attends condemnation by the Federal authorities, and in the absence of power vested in the board of health to compel local authorities to provide water supplies which are reasonably pure, the Federal regulations have been of great service.

Doctor CUMMING. May I suggest right here that all resolutions should be in by noon.

Is there any further discussion?

Doctor CHESLEY. I did not hear Mr. Emerson's paper, so he may have mentioned this point, but it seems to me that it might be possible through the service to get the National Board of Insurance Underwriters to take some action with relation to these emergency intakes for fire purposes, which so frequently are connected with the water-supply system. In Minnesota there is no trouble about it, but a uniform policy throughout the United States would be promoted by cooperation on the part of the National Board of Insurance Underwriters. The industrial insurance organization is in accord with public-health measures, and if this health phase of the fire-insurance organization could be brought to their attention it might aid the States in securing better and more prompt action with regard to the emergency intake.

Doctor CUMMING. Doctor Frost is going to discuss the question of colon bacillus as an index of potability of water.

SIGNIFICANCE OF B. COLI IN WATER.

Doctor FROST (reading):

I feel that an apology is due an audience for undertaking to discuss a subject which has already been discussed so much as this, especially when it is certain that nothing new will be added. What is known with reference to the significance of *B. coli* in water in relation to health is the result of so many years of cumulative experience that what can be added by one or two years more of observation can have very little effect upon the sum total. Consequently, anything that may be said properly representing opinion to-day is in most respects identical with what would have been said some years ago, since, so far as I am aware, the last 10 years have seen only one important addition to our knowledge, materially affecting opinion on this subject.

Sanitarians are interested in water supplies primarily as potential vehicles of infection. What they wish to know regarding a water supply is its danger, in terms of the proportion of consumers who will contract infection as a result of drinking it. A knowledge of the water in terms of bacteriology is of secondary interest to them, solely as a means toward the end of forming an estimate of the water's danger.

The facts upon which an interpretation of a bacteriological or chemical examination of water is based are relatively few and simple and are so generally known that they are repeated here merely by way of review.

The first fact of importance is that the real element of danger in a water supply is the pathogenic microorganisms which it may contain.

The second essential fact to be recognized is that we can not at present demonstrate these dangerous pathogenic microorganisms in water by direct bacteriological processes, because they are present in such exceedingly small numbers as compared to other nonpathogenic organisms. To detect the typhoid bacillus, or other pathogenic bacteria, even in grossly polluted water, is a rare accident; and failure to detect them is by no means proof of their absence.

The third fact essential to the interpretation of any chemical or bacteriological examination of water is that all of the pathogenic microorganisms which constitute a real danger in water are essentially parasitic, having their natural habitat and breeding place in the bodies of man and other higher animals. Outside of this environment they tend naturally to rapid decrease or extermination, and therefore they are found in nature only in association with comparatively fresh excreta. Moreover, the pathogens of most serious importance are found only in human excreta, not in the excreta of lower animals.

Therefore, since we can not directly demonstrate the pathogenic organisms which may be present in water, our next most specific test for their presence is demonstration of the presence of excreta, especially human excreta.

For many years, with this general principle in mind, chemists and bacteriologists have been working toward specific tests for excreta. The problem is, however, a difficult one, for while the contamination resulting from a very small amount of fecal material added to pure water can readily be detected by either chemical or bacteriological tests, these tests do not prove that the contamination necessarily resulted from excreta. The most nearly specific chemical tests serve only to indicate broadly the kind and to measure roughly the amount of organic matter present. They do not differentiate between organic matter derived from sewage and that from less objectionable and entirely harmless sources. Similarly, the total numbers of bacteria as determined by gelatine or agar counts may be taken as indicating roughly the amount of organic matter present which is suitable for the sustenance of bacteria; but, although large numbers of bacteria are present in excreta, equally large numbers may be found in other organic wastes. Consequently the demonstration of excessive numbers of bacteria in water, taken by itself, does not indicate sewage contamination.

The most nearly specific test for excreta at present available is demonstration of the presence of the so-called "colon bacillus," since this organism is always present in large numbers in the excreta of human beings and higher animals. However, before this test can be considered absolutely specific, it is necessary to prove that the colon bacillus breeds naturally only in the bodies of man and other animals. It is upon this latter point that there has been and is considerable controversy—naturally, since such a proposition can be proven only by exclusion, and even an approximation to proof requires an enormous mass of negative experience.

Notwithstanding the impossibility of absolute proof, a large majority of sanitarians in this country familiar with the bacteriological examination of water would have stated quite positively 10 years ago that the presence of colon bacilli as then defined was definite and specific evidence of fecal contamination. They would have based this opinion upon their general experience that these organisms were ordinarily found only in waters which were obviously subject to fecal contamination, and that the numbers of colon bacilli found were roughly proportional to the exposure of the water to fecal contamination as shown by sanitary survey.

On the other hand, there was a very considerable and highly authoritative minority, especially strong in England and Germany, who held the opposite view—that the colon bacillus, though always present in feces, was widely distributed in nature as a saprophyte, and that its presence did not necessarily indicate the presence of excreta. Their reason for this view was chiefly that a large number of studies had shown the presence of colon bacilli on grain, grasses, and fruit, and in soil where the probability of recent fecal contamination seemed extremely remote.

In 1913 and 1914 Rogers and Clark, of the United States Department of Agriculture, began what proved to be a fundamental piece of research. Using highly refined bacteriological and chemical methods, they demonstrated conclusively that the so-called *B. coli* group, which had previously been considered one group of bacteria, really comprised two separate and distinct groups, one representing "true *B. coli*" and the other a similar but distinct "aerogenes group." These two groups, which gave more or less identical reactions by tests previously applied, were distinctly differentiated by different ratios of hydrogen to carbon dioxide in the gas formed and by different hydrogen ion concentrations established in special media under standardized conditions. The differentiation as first made by Rogers and Clark required rather elaborate apparatus and technique, beyond the reach of most water bacteriologists; but subsequently, as a result of work by Doctor Clark and others, the technique was greatly simplified, so that the differentiation can now be made by very simple tests, requiring no special apparatus.

Applying these tests to large numbers of cultures derived from different sources, Rogers and Clark found that the colon bacilli found in feces, whether human or animal, belonged almost exclusively to one group, which they called the "fecal group," while the colonlike organisms found on grain belonged usually to another group, which they called the "nonfecal" or "grain" type. Their work is still relatively new, but already it has been confirmed by quite a number of independent observers, and, so far as I am aware, all subsequent work tends to establish the original conclusions arrived at by Rogers and Clark—that the "fecal type," or true *B. coli*, is predominant in fresh feces and in material exposed to fecal contamination, while the colonlike organisms found on grains and in unpolluted soil almost invariably prove to belong to the "aerogenes group."

As to the significance of this, a good many sanitarians appear to have the impression that it renders the ordinary test for *B. coli* less significant than previously. While this may be a natural viewpoint, it is not justified. It is true that a positive test for *B. coli*, made according to present standard methods, may indicate the presence not of true *B. coli* but of the nonfecal aerogenes type. But this has always been true, though not previously recognized; and the probability that a positive standard *B. coli* test in water means fecal contamination is just the same now as it was 10 years ago. Moreover, in cases of doubt or special importance it is now possible to carry the test further and determine whether the organism is true *B. coli* or aerogenes. Also, this recent work appears to offer a satisfactory explanation of the finding of so-called *B. coli* in the past in situations where their presence could not be satisfactorily accounted for as due to fecal contamination. Presumably these organisms were of the aerogenes type, not true *B. coli*.

The American Public Health Association has not yet made it obligatory in their Standard Methods to differentiate *B. coli* from aerogenes, but they describe the technique, so that any reasonably well-trained bacteriologist can make the differentiation. In the absence of such differentiation a positive test should be interpreted as heretofore; that is, as constituting strong presumptive evidence of fecal contamination. Admitting that this is not positive proof, the benefit of the doubt should be given to the public and the contamination should be considered as of fecal origin unless evidence is brought forward to the contrary.

So far the discussion has referred only to demonstrating the presence of contamination with excreta; but even granting that the presence of excreta is demonstrated and the extent of the contamination measured, this still is not equivalent to measuring the danger of the water in terms of the probability that it will cause infection. For this several further steps are necessary.

First, it is necessary to differentiate between excreta from lower animals and that from human beings. As this can not be done by means of chemical or bacteriological tests, it requires a survey of the sources of contamination to which the water is exposed. This may afford more or less definite information. For example, *B. coli* is of much more dangerous significance in a well obviously contaminated from near-by privies than one not subjected to contamination from privies but located near a heap of stable manure.

However, even the demonstration that water is contaminated with human excreta does not necessarily indicate that it is immediately dangerous and falls far short of measuring its danger. A well or spring grossly contaminated from a privy and used by a small number of people may not be actually dangerous merely because none of the people contributing to its contamination is infected with any pathogenic organisms. Such a well, though very offensively polluted, may not cause any infection within a generation. On the other hand, it is quite certain that a river such as the Ohio, which constantly receives sewage from several millions of people, always contains typhoid bacilli and other pathogenic intestinal bacteria. This is necessarily so because among the millions of people whose excreta reach the stream there are always a very considerable number harboring pathogenic bacteria, either as active cases or as carriers. The only question as to such water is not whether or not it is dangerously contaminated but to what extent.

But even when it is known that a water contains typhoid bacilli or other pathogenic bacteria, this still does not constitute an active measure of its danger. Even if we knew the exact number of typhoid bacilli per thousand liters of water, we still would not know what proportion of the people drinking this water would become infected, because we know practically nothing as yet regarding the dosage necessary to cause natural infection. Nor have we more than the vaguest ideas as to the relative danger of waters containing different numbers of pathogenic bacteria. For example, if a water containing 10 typhoid bacilli in a certain volume will cause infection in 10 per cent of the people who drink it, it by no means follows that a water containing one typhoid bacillus in the same volume of water will cause 1 per cent of infections. Conceivably it might still cause the same proportion of infections as the more highly contaminated water, or it might cause none. We simply do not know the effect of varying dosage of infective organisms.

The nearest approach that has been made to the exact knowledge of the danger of water supplies, in terms of the number of cases of infectious disease which they will cause, has been made not by bacteriological studies but by epidemiological observations. For instance, our estimate of the danger of raw water from the Ohio River is based not on its bacteriological examination but on past experience in cities where this water has been used; an experience which has shown that 1 per cent or more of the consumers develop typhoid fever each year, whereas the same cities when using more or less adequately purified water supplies have not suffered much more than one-tenth such a typhoid incidence rate.

I have dwelt upon the difficulties and indirection of estimating the danger of water supplies, not with a view to casting doubt upon the value of bacteriological examination but merely to emphasize the point that the sanitarian who attempts to estimate the quality of a water supply must take into consideration not only the bacteriological evidence of pollution but also the character of the sources from which the pollution presumably comes.

In extreme cases an interpretation may be very simple. For instance, a water which consistently gives negative *B. coli* tests and very low bacterial counts may be pronounced safe so far as infection is concerned without knowing anything more about its origin. Equally, the water from a stream known to receive the sewage of a city a short distance upstream may be condemned as unsafe without the formality of a bacteriological examination. It is the intermediate cases which are difficult; those in which bacteriological examination shows moderate contamination and a sanitary survey reveals exposure to possibly though not certainly dangerous contamination. As to such cases there is always room for perfectly legitimate differences of opinion, which can be proven only when epidemiological evidence shows that the water is responsible for infection or that it is causing none. It was circumstantial epidemiological evidence which first proved the agency of water supplies in spreading infection, and it is evidence of the same kind, rather than direct bacteriological evidence, which best serves to-day to establish and measure the danger of a water supply.

Doctor CUMMING. Is there any discussion?

Doctor GARRISON. I would like to ask a question, to throw what light I can on the question of domestic animals that have colon bacilli. This matter came up at Hot Springs, where the Government and the State are involved. The limited literature at my disposal did not disclose very much on it. I would like to have him tell us about that if he can.

Doctor CHESLEY. I will ask Doctor Park to answer that. I believe all the higher or lower animals, all animals and fowls, have colon bacilli very abundantly in the feces.

Doctor GARRISON. That was my general impression, but the textbooks down there were to the contrary.

Doctor PARK. There was rather an extraordinary condition in New York. We found colon bacilli increased very rapidly in the reservoir after being purified. Suspicion was directed to a flock of gulls that came over. This year when they came over again we found colon bacilli. I would say that apparently nearly all wild animals and fishes produce it.

Doctor STILES. In connection with the question of drinking feces through the drinking water it is interesting to note that we have entirely independent tests which go to prove definitely that we all eat human feces. An advantage of one of the tests which we have is that we can tell definitely that the fecal material we have consumed comes from human beings. In entering almost any locality we can prove microscopically that anywhere from 10 to 90 per cent of the population have actually swallowed human excreta. There is no doubt but that 20 per cent of us would give a positive test, while if we go out to the people in the rural districts and among the cotton-mill population we can run that up to 70 or 80 or 90 or 100 per cent. According to the average population in Washington it would run between 10 and 20 per cent, so that we all eat human excreta, quite independent of any test we have from the bacteriological view in regard to colon bacilli. The other test which I have mentioned has great advantage, in that we can prove it is definitely human excreta.

Doctor CUMMING. Doctor Park needs no introduction to any health officer in the country. He will now talk to you.

TOXIN-ANTITOXIN, AND THE SCHICK REACTION.

Doctor PARK. It is difficult to decide just what aspects of the Schick test and the toxin-antitoxin injections to take up before a body of trained health workers. If I treat in too general a way any portions that you wish to hear more about, I hope you will ask questions in the discussion.

In the February monthly bulletin issued by the New York City health department I have summarized all the experimental and practical work done on the Schick test and the production of active immunity. Copies will gladly be sent to any who request them.

The Schick reaction: This is a very dependable test if the correct amount of toxin is given intracutaneously. If the injection is faulty either in the amount given or in the method, it gives misleading results and is not a true Schick test. If too much toxin is administered, too many of those injected react; if too little is given, we obtain too few reactions and have a false feeling of security. If the toxin is not injected entirely intracutaneously, it is not retained in the skin and so does not produce its full local effect. The first essential, therefore, is that the laboratory should test the toxin and send it out in just the right amount. Until very recently the laboratories have frequently erred by supplying either an excess or a deficiency in the amount of toxin, and thus getting too large or too small a proportion of positive Schick reactions. The deficiency has been due not to the fact that too little toxin was put in the container, but because we did not realize that the glass of our containers, whether bottles or tubes, is often unsuitable and affects the toxin badly. Within even a few weeks improper glass will cause a great deterioration in the toxin.

Some time ago, because of certain results reported to us, Doctor Zingher asked the manufacturers of biological products to send us a number of their outfits. In over 80 per cent of them we found that the toxin was deficient in amount. Last summer the manufacturer who had always supplied us with suitable glass felt aggrieved at the way the contract had been awarded and sent us an inferior article. As we had tested the toxin put up in his glass tubes for many years and had not found any deterioration, we omitted to test this lot. Soon we got a report that our toxin, used in comparison with that of another biological plant, gave less reaction. Samples of both toxins were sent to us, and we found that ours had 40 per cent and the other had 180 per cent of the required amount. Just recently we had a portion of a bottle of toxin sent us which had been prepared by a private manufacturer and had been held for six months, with the comment that 100 children had been Schick tested without a positive reaction. We sent them some of ours, and on the retest 30 per cent of these same children reacted positively. If any health officer tests 50 or more children with toxin and no characteristic reaction develops, he can be sure that the toxin is unsuitable and should be discarded. These incidents are merely samples of many in which I know the results of the tests were faulty. We can sum up by saying that a suitable Schick test is extremely reliable, but that many so-called Schick tests, because of faulty toxin or faulty technique, are misleading.

What proofs have we that a negative Schick test does give us assurance that sufficient antitoxin is present to supply protection against diphtheria? You realize that Schick tried to select for the intracutaneous test a definite amount of toxin which, if it gave a reaction, showed the case was not immune because of antitoxin; if no reaction developed that the case was immune. To find an amount which would make such an absolute separation of cases would be too much to expect. Antitoxin which would just prevent a diphtheria infection under ordinary conditions of health could hardly do so if the case were complicated as by measles or tonsillitis. If the minimum amount to prevent a Schick reaction did not always prevent a slight local infection, would there be enough antitoxin to prevent a serious development of diphtheria? I have studied this matter carefully and I am perfectly sure that there are cases occasionally with slight tonsillar exudate and positive cultures that have the negative Schick test. For instance, last week at the institution of St. Dominicks, where there are 1,500 children and where we have been giving the toxin-antitoxin at intervals for seven years, it was recently reported that they had two children with suspected diphtheria who had given negative Schick tests last January.

One of the children had developed a tonsillar deposit and a temperature of 103. At the end of the second day a culture was made. On the third day, because of a positive report on the culture, antitoxin was given, but the child had already improved.

The other child showed a slight sore throat but no exudate. The culture was also positive. Did these two children have diphtheria?

In one case recovery began before antitoxin was administered. In the other no antitoxin was given and no exudate developed.

You may remember a report of mine in regard to an institution in which all the children had given some months, before the negative Schick test, yet seven children developed tonsillitis with patches within a week's time, and all were shown to have diphtheria bacilli. All the children but the last one received antitoxin, and this one, like the others, recovered promptly. If I had not withheld the antitoxin from the last case it would have been thought that antitoxin had cured the others.

In a hundred other little children living in different wards in this institution no suspected cases developed, yet when we made cultures we found the extraordinary condition that over 50 per cent of these children carried virulent diphtheria bacilli in their throats. My interpretation of these cases is that it is possible under unusual conditions, such as an infectious tonsillitis, together with a diphtheria-carrier condition, to develop a slight diphtheria even in cases having just enough antitoxin to give the negative Schick test, but I believe these cases will never be severe and will recover without additional antitoxin.

Before taking up active immunization let us consider the need of additional measures to combat diphtheria. We have noticed in New York, Pennsylvania, Massachusetts, Connecticut, and other places that there has been only a moderate decrease in the number of cases through the use of isolation guided by cultures, and the use of immunizing doses of antitoxin has been very much greater, for the deaths have been reduced to one-fifth their previous number.

It is rather interesting that during the last nine years the diphtheria mortality in New York State, outside of the city, has risen from about 11 per 100,000 to 18 per 100,000. In New York City it rose from 19 per 100,000 in 1916 to 22 per 100,000 in 1919. Up to 1920 there were in New York City about 15,000 cases and 1,200 deaths a year. These facts make us appreciate that we have not yet conquered diphtheria. The only additional measure that seemed immediately available was the testing out of the value of active immunization with diphtheria toxin modified by antitoxin. With the Schick test it became very easy to test whether toxin-antitoxin injections in children would give antitoxic immunity; and if it developed, to test its duration. Babes away back in 1895 showed it developed in guinea pigs and that it lasted at least for some months. Some years later Theobald Smith showed it lasted about two years. Could we expect it to last longer in a human being than in guinea pigs? We could at least hope that it would, because there is some tendency in a human being to develop and maintain natural immunity. Whether this natural development of antitoxin is due to the person becoming a carrier or is an inherent condition we do not know, but the fact gave us the hope that if antitoxic immunity were once developed it might be a permanent acquisition.

The toxin-antitoxin vaccine: Why did we choose the mixture we are using? We knew from animal experimentation on horses and guinea pigs that a tremendous amount of slightly overneutralized toxin could be safely injected and give more antitoxic response than a safe dose of straight toxin. We did not know how much toxin to use in children, but we started off to use in 1 cc. of mixture three L plus doses of toxin neutralized to such an extent that 5 cc. of the mixture would produce paralysis in a guinea pig. This mixture was effective, but because of the large amount of bacillus protein in it it caused in some severe reactions. We also tried giving five L plus doses of neutralized toxin. This gave us no better results, and so I determined to try one-half of an L plus dose and also one-tenth of an L plus dose of toxin. The children receiving the one-tenth L plus as a dose have almost no annoyance from the injections. In the only school in which we have made retests the results are as good as with those receiving the three L plus doses.

The immunizing results: At my request Doctor Zingher selected in 1915 a number of institutions where the children remained for some years. He Schick tested the children, and he and Doctor Schroder have retested them year by year. It has been found that in nearly all cases a child becoming immune remains so for at least six and one-half years. Very few relapses have occurred, and the children who relapsed became negative and remained so when reinjected with toxin-antitoxin. Possibly we are a little too optimistic in our estimate of the duration of the immunity, because in injecting the children every one or two years with toxin of the Shick test there may be a little stimulus to the development of antitoxin. To eliminate this factor we shall not make retests in certain institutions and schools until after the lapse of a number of years.

In New York we have had absolutely no serious consequences from the administration of the toxin-antitoxin. We have had, of course, the usual proportion of swollen arms. Fortunately, little children under 3 years seldom develop annoying reactions except slight local swellings and temperatures. The older children have in about 10 per cent sore arms for two or three days, with or without some rise in temperature. When we first started the injections we prepared our own toxin from bouillon made from meat which was allowed to ferment through the multiplication of the germs clinging to it. In this first fermentation certain slightly toxic products were occasionally formed which were not destroyed by the subsequent heating. These products created a disturbance in certain individuals. Indeed, we had four cases in which there were definite toxic effects; these children were prostrated for a few hours. Since then we have used nothing but the soluble products of fresh sterilized meat for the nutrient medium. To this has been added the colon bacillus to ferment the sugar, and then the diphtheria bacillus to provide the toxin, so there can be no proteins in the toxin broth except from the diphtheria and colon bacilli and from the meat itself. We are now testing out a product which has only one-thirtieth of the bacillus protein that the present preparation contains. If this new mixture answers as well as our present one, we will greatly lessen these annoying reactions, and so remove the only real objection to the injections.

Supposed illness following the injections: If hundreds of thousands of children are injected, there will surely develop in some illness which is a mere coincidence and not due to the injections. As an illustration I will mention something that happened some years ago. I asked a physician to go to Staten Island to inject an infant with toxin-antitoxin. On account of a sudden storm he deferred his trip until the next day, and then found the child had died of convulsions during the previous night. If he had injected the child at the time set, it would have been thought that the vaccine had killed it. Among the 60,000 children that have received the injections through us there is only one in which death has occurred within a period of a few weeks. This child died of meningitis. The only possible connection would be that the toxin-antitoxin lowered the child's resistance and so made infection possible.

The value of immunization of school children: The attempt to immunize the school child is worth while, both because of the actual protection given and because it paves the way to reach in the same families children of pre-school age, who are really the ones most in need of protection. We believed that if every parent of a school child should receive a letter from the department of health urging immunization against diphtheria, it would make an immense impression on the people of the city of New York and it would help to persuade the parents to have the younger children receive the injections either from the health officials or from their private physicians.

For these two reasons we have devoted ourselves during the past two years chiefly to the schools. By June almost every public-school child in New York will have received a circular of information to take home; nearly 300,000 of them will have been Schick tested, and. if necessary, given treatment. With the closing of the schools we expect to make a drive to vaccinate the children who are too young to go to school.

Certificates: These are given in two forms. The first simply states that the injections have been received, the other that a retest has established immunity. One should never give a certificate of successful immunization after merely giving the injections, because we know that anywhere from 10 to 30 per cent of the nonimmunes will not be fully protected from diphtheria by one series of injections. Such a certificate may give a false sense of security to the parents. We therefore issue immunization certificates only after a negative Schick reaction at the retest. Retests are made four to six months after the completion of the injections.

The results observed among the test children: We have indexed 90,000 children who have been Schick tested by the physicians working under Dr. M. C. Shroder and Dr. A. Zingher. About 80,000 of these had an originally negative Schick test or the retests after the injections were negative. About 10,000 of those who were originally positive and who received two or three injections have not been retested or on retest were found to be positive.

The following table gives our findings:

TABLE 1.—*Number of suspected cases of diphtheria developing in 90,000 untreated school children and in 90,000 who had been Schick tested and when positive given two or three injections of toxin-antitoxin.*

Number of children.	Result of Schick test.	Result of retest, if retested.	Number of reported cases of suspected diphtheria.
60,000	Originally negative	Not retested } 80,000	{ 4
20,000	Originally positive	Became negative }	{
8,200	Positive	Not retested	4
1,800	.....do	Remained positive	4
90,000	Tested and when necessary injected		12
	Neither tested nor injected, controls		54

Summary: Among the 90,000 untreated school children there developed 54 cases of probable diphtheria during the past four winter months. Among the 90,000 school children of the same ages who were Schick tested last spring and, when positive, given two or three injections only 12 developed the disease.

Of the 90,000 tested children, about 80,000 were either originally negative or on retest after the injections found to be negative to the Schick test. Only four of these 80,000 developed suspected diphtheria. This demonstrates that a negative Schick test indicates an almost complete immunity to diphtheria.

Among the 8,200 who were originally Schick positive and were not retested after the injections, 4 cases developed. These 8,200 were, as a rule, among the latest to receive the injections. The 1,800 who in spite of the injections developed insufficient antitoxin to prevent a moderately positive Schick test showed the highest incidence of the disease. This result emphasizes the necessity of a Schick test several months after the injections. Those who still give the positive reaction should receive a second series of injections. You may not realize that we have as a protection from diphtheria both antitoxic and bactericidal immunity. There is no practical way to test the bactericidal immunity.

Doctor CUMMING. Before beginning the discussion we can take up the allied papers—"The effect of distribution by the official agencies of biologic products on child morbidity and mortality." Doctor Hayne will talk about this.

DISTRIBUTION BY OFFICIAL AGENCIES OF BIOLOGIC PRODUCTS ON CHILD MORBIDITY AND MORTALITY.

Doctor HAYNE. This is an unexpected honor, but I always have an impromptu speech with me. I am not a scientist. I am a plain, blunt man who loves my fellow men and women and children.

South Carolina has the unique position, which will be disputed by the majority of the States, of actually distributing diphtheria antitoxin free to its citizens. A great many States claim to do this, but do not do it. We distribute it free to every citizen in South Carolina, and there are no strings to it. Whether this does good or whether it does harm we are prepared to prove by mortality statistics. Morbidity statistics are about as inaccurate in South Carolina as they are in Maryland or Massachusetts. Therefore we lay no stress upon morbidity statistics, but our mortality statistics are about 90 per cent correct. We believe that because they have been investigated and accepted by the Census Bureau, which is a department of the Federal Government, and therefore can not err.

We have been following our statistics in South Carolina since 1915, when we entered into the registration area, and that is only a period of seven years, and we are sorry to say that our death rate in diphtheria is going up rather than going down.

We started the free distribution of diphtheria antitoxin in 1908, so that we had been distributing it seven years before we got our first reliable mortality report. I believe that in about 1890 or 1900 the mortality statistics for the United States showed that there were 43 per 1.000 deaths from diphtheria in the United States, and the average mortality in 1918 was about 18 per 100,000 of population. The average mortality in South Carolina is about 6 per 1,000. This is the lowest mortality of any State in registration area except Vermont, Montana, Washington, and Colorado, and, of course, in Montana, Washington, and Colorado, especially Montana, the distances are so great between carriers and between individuals that there may be some reason for that low mortality in Montana outside of the climate.

In Vermont we can only attribute it to the fact that Vermont, like South Carolina, is a rural State to a great extent, and it has an excellent State health officer in charge of its affairs.

Joking aside, we feel our method of distribution of diphtheria antitoxin is ideal.

I would like to read you a clause of the contract that we have with a biological firm for the distribution of antitoxin. We used to manufacture it, but after having killed four children in one summer—or at least we were so accused—and having a $25,000 verdict brought against the State, we feel a sort of delicacy in manufacturing and we prefer to let some biological firm take the responsibility. In other words, we are passing the buck. I will read you this clause that I referred to.

(Clause referred to read.)

I read that to show what we are doing in that respect. The antitoxin is put in every hamlet in South Carolina. South Carolina is 85 per cent rural, and there are no cities except Charleston. The rest are really overgrown villages. At no point in South Carolina is a depot more than 5 miles from a doctor. A doctor can get any amount of diphtheria antitoxin free, from 200,000 units to the proper amount, which, if the case is recognized in time, is about 5,000 units, or not over 10,000. Of course, as I say, I am not a scientist, but the amount they get usually cures them.

We have found, of course, that there is a large amount of diphtheria antitoxin administered to children who do not have diphtheria, but we have not found any bad results occurring in the children or any deaths on account of giving diphtheria antitoxin, whereas prior to the administration of diphtheria antitoxin there were very bad results from those who did not get diphtheria antitoxin where they had diphtheria.

I believe there is no single measure that has done as much toward reducing the death rate amongst children with diphtheria as the fact that a doctor can get it free, that he does not have to make out a pauper's certificate to get it, that it is easier for him to give it than not to give it, and for that reason I think our method is the best that I know of.

It costs the State—and we are dealing with budgets nowadays, so you are interested—it costs South Carolina about $13,000 to give this. That is the maximum amount it ever cost. We have a population of 1,700,000 people, black and white, and it is not a prohibitive cost to give it free.

Take your big States and proportion it to that amount, say $1,000 or $750 per 100,000 of population, and you get the price. I would like to briefly tell you what we are doing with the Schick test and toxin-antitoxin.

I may not have completely understood Doctor Park. My impression was they did the Schick test before giving the toxin-antitoxin. We give the toxin-antitoxin to every school child, regardless of whether they are positive or negative. That is expensive, but we are doing it as an experiment in one county—the county of Charleston, outside the city of Charleston. We have immunized and card-indexed 3,000 children in the county. We propose to find out in a year or two whether those children have diphtheria, how many have it, and in that way we will be able to report something worth while in regard to the immunization of children with toxin-antitoxin. We give the typhoid and paratyphoid free, and it gives a tremendous reaction; therefore the slight reaction from the toxin-antitoxin is appreciated by the people. We do not distribute it free in the State unless we are convinced that the physician who obtains the toxin-antitoxin is capable of administering it, and whenever we are in doubt we have them come to the laboratory and show them how to administer it.

Doctor CUMMING. The next topic is "State-wide programs for the application of the Schick test and toxin-antitoxin immunization." Doctor Nichols was here and had to leave. We will proceed with the next question, which is "Standardizing technique," by Doctor McCoy, director of the Hygienic Laboratory.

STANDARDIZING TECHNIQUE.

Doctor McCOY. It is traditional with men who work on the same line with Doctor Park that after he has spoken on diphtheria nothing remains to be said. Doctor Park, however, refrained from taking up the matter of standardization of the agents under discussion, and it is on this point that I will speak briefly.

Introductory to this, I should like to say it appears that in the Schick test we have about the only truly logical and scientific prophylactic inoculation in use, because by means of the Schick test we find out in advance just what particular persons need immunization and then proceed to immunize them with the toxin-antitoxin mixture. In the case of typhoid, smallpox, and other prophylactic vaccinations we immunize everybody and doubtless immunize many who have a natural immunity to the disease in question.

Standardization of the Schick test has recently been ruled by the Surgeon General's office to come under the provisions of the law of July 1, 1902, which requires that a license shall be obtained by the manufacturer before selling the product in interstate traffic. The details of our efforts at standardization would not be of special interest to you, but you will be interested to know that the manufacturers are required to send samples of each batch to the Hygienic Laboratory for testing and approval before they distribute it. The same thing applies to the standardization of the toxin-antitoxin mixture. Before we undertook this work there had been a considerable variation in the strength of the preparation, and there had been one very disastrous accident in the Southwest, where a mixture was sent out so highly toxic that it resulted in a number of fatalities. The present means of control is believed to insure two things; first, an efficient preparation and the distribution of a product having the proper degree of toxicity; and, second, no dangerously toxic preparation will be distributed.

In connection with Doctor Haynes's discussion, I think it is proper to state that no one need be discouraged with respect to the expense involved in the free distribution of antitoxins. There has been such active competition recently between the manufacturers that the price at which antitoxin can be supplied is amazingly low. I am acquainted with one State contract recently in which the price was something like 20 cents for the 1,000-unit package, 48 cents for the 5,000-unit package, and 98 cents for the 10,000-unit package.

Doctor CUMMING. Is there any discussion of these papers?

Doctor DILLON. These papers which we have just listened to have been very valuable ones. There are one or two statements, made or implied, by Doctor Park with which we have to disagree, and that was the statement, if I understood him correctly, with reference to the question of diagnosis of the mild case of sore throat in which there was a slight formation of a false membrane, and a positive laboratory finding of diphtheria bacillus. It seems to me there should be no question as to this being diagnosed as a case of diphtheria. I believe for the protection of the public a person with diphtheria should be isolated and quarantined; likewise, a person who is a carrier of what has proved to be a virulent strain of diphtheria bacilli. In my opinion, the public has a right to demand protection by their isolation so long as they remain a carrier. During the past six weeks my attention has been invited to a death in which the cause of death was given as spasmodic croup. We refuse to accept spasmodic croup as a cause of death, but have preferred to treat it as a probable case of diphtheria and prohibited the holding of a public funeral. The attending physician assured me that this child, who was 3½ years of age, and who had been sick three days, had no evidence of a sore throat, but a post-mortem which was held disclosed a larynx whose mucus membrane was covered with the diphtheritic exudate. Smears made from this membrane and examined in the laboratory confirmed the diagnosis by the presence of Klebs-Loeffler bacillus. An interesting thing in this connection is the fact that this body had been embalmed 18 hours prior to the holding of the post-mortem. Our laboratory made every effort possible to obtain a growth from the specimen of the diphtheria membrane, but in every instance was unsuccessful. In my opinion, this child died not as a result of the toxins of diphtheria but because of the mechanical obstructions of the larynx from the diphtheritic membrane. Yet the attending physician assures me that it had no clinical evidence of the sore throat. I would like to ask Doctor Park if this is not a diphtheria death, what is it?

Doctor **Rawlings**. I would like to ask Doctor Park the following questions: How many of his series of 90,000 had three separate injections of toxin-antitoxin; and, does glassware affect toxin-antitoxin as well as the toxin used in the Schick test?

I wish to ask Doctor McCoy if the Hygienic Laboratory pays any attention to the quality of the glassware used for these biological products?

In Illinois we distribute antitoxin to rich and poor alike. We have in Chicago and other sections of the State approximately 400 places where diphtheria antitoxin and other toxins and sera may be obtained. In spite of a very favorable contract these products cost the State of Illinois over $40,000 a year.

We have not been able to obtain as good results as we had hoped for from the general use of free antitoxin in the reduction of our mortality from diphtheria, either in Chicago or in the rural districts. I wish we could report as favorable results as those given by Doctor Hayne. We believe it is a worth-while procedure in aiding in reducing the death rate, but I think health officers must concede that our best hope in rendering our communities immune lies not in the diphtheria antitoxin but in the general use of toxin-antitoxin. This is especially true because of the big carrier problem. Many of these carriers have virulent diphtheria germs constantly in their throats and we must make immune those who are in contact with these carriers.

Doctor **Cumming**. Is there any further discussion?

Doctor **Mitchener**. From the comments voiced this morning there has seemingly been a greater effort made to immunize children of school age with toxin-antitoxin than there has been to immunize those between 6 months and 6 years of age. In North Carolina we have not put forth as much effort to give toxin-antitoxin to children of school age as in the six-months-to-six-years group, because in this group we get a larger percentage of our cases and a higher death rate.

Early in the spring of 1921 it was decided to offer toxin-antitoxin in our county-wide campaigns which, as most of you know, we have been conducting in North Carolina for several years. We advised the older children and the adults to take typhoid vaccine and the younger ones to take toxin-antitoxin. The response was exceedingly gratifying, not only as to the large number of people who received three treatments of typhoid vaccine (70,000, or about 16½ per cent of the population of the area worked) but also a large number immunized against diphtheria, 10,000 having taken three doses of toxin-antitoxin. In Green County, which has a population of about 16,000 people, 4,529 were given the typhoid vaccine and 1,238 took toxin-antitoxin.

I might state that we have ignored the Schick test entirely because of—

(1) The trouble—since we can immunize with about as little work as one meets in giving and observing the test.

(2) Lack of experience on the part of the men in interpreting the reaction.

The large number immunized in these campaigns is attributed to the fact that the treatments were administered by local physicians, from one to eight participating in each county.

Doctor CUMMING. Is there any further discussion? Doctor Park, would you be good enough to answer the questions?

Doctor PARK. Let us consider first the question as to the propriety of the free distribution of unlimited amounts of antitoxin by State and city departments of health.

An example will help to explain my position. A physician recently called up the laboratory and asked for 250,000 units of tetanus antitoxin. The physician in charge explained to him that 100,000 units would cover the requirements of any case however severe. He answered, "I am asking for antitoxin; not for advice." So he was told, "You can have 100,000 units free, but if you want any more you will have to pay for it." He replied he did not wish to pay for any, so he would take the 100,000 units offered.

I think that a health department should distribute free any reasonable amount of a biological product, but beyond that it should make a charge. No one up to this time has paid a cent for anything beyond the amount we thought suitable. The conviction among physicians, therefore, is not very strong for these tremendous doses. When physicians receive serums free they are apt to think in excessive amounts. They do not seem to realize that 10,000 units of diphtheria antitoxin are one hundred times as much as would be required to neutralize the greatest amount of toxin that any case ever had. We give as much as 10,000 units so as to get sufficient antitoxin quickly through the capillary walls to the diseased tissue, just as we pour enormous amounts of water on a burning building, more than would be required, if it could all reach and remain in contact with the actual materials on fire.

The necessity of the use of the Schick test before the toxin-antitoxin injection depends on the actual conditions as to the age of the children and the help available. Under 3 years of age I think very few of us would advise a Schick test, except in family practice or in institutions where one is in contact with the children, and may repeat the test from time to time. The immunity derived from the mother is usually lost in the first year, but some children hold it for two or three years; therefore, a negative Schick test for this age is not a positive sign of permanent active immunity. After three years the Schick test, besides eliminating those who are negative from those to be injected, has the great value of proving in these latter whether or not there is a lasting immunity. After 6 years of age only about one-half of the children require toxin-antitoxin, and it is therefore usually wise to give the test. Yet because we do not need the same expert supervision for the injections as for the test and because by omitting it we save time, it may be better even after the age of 6 to give toxin-antitoxin without the Schick test.

If the toxin-antitoxin is given to all, there is the advantage, of course, of getting a little credit for immunizing those that were already immune.

Before I forget it I want to speak in regard to the enormous value of Doctor McCoy's supervision of the biological products. His trained staff of workers at the central laboratory checks the results obtained by all of us in our laboratories and so gives to us and the public an added safeguard. One serious accident that happened some time ago would never have occurred if the manufacturer had sent his products to Doctor McCoy for control tests. By keeping in touch with all, Doctor McCoy is able to make regulations of great value which almost prevent the possibility of mislabeling or accident.

I think that I was misunderstood as to the question of the practical application of the cultural test to treatment and diagnosis. It is strange for me to defend my present ideas since I believe I introduced the culture test. When cultures were proposed in New York City in 1893, I remember I thought we could gradually eliminate diphtheria by separating those who were infected with the bacilli from those who were not. This hope was not fulfilled because the healthy carrier was found to be so widespread that the isolation of cases had little effect on the general morbidity rate.

The culture shows simply whether a diphtherialike bacillus is present or not and does not make a diagnosis. Except where characteristic membrane is present, the clinical signs may also fail. Doctor Thompson showed that about 10 per cent of the cases of laryngeal stenosis received at the Willard Parker Hospital were not infected with diphtheria bacilli and had no exudate or pseudo membrane in the larynx. This catarrhal inflammation causing stenosis is apt to appear before a child develops a measles rash or during an attack of so-called influenza.

Some time ago the director of the bureau of hospitals of the department of health had a bad patch on his throat and he thought it to be diphtheria. Antitoxin was given immediately and a culture was made. The culture turned out to be negative. If bacilli had been present, we would have called it undoubted diphtheria, while in fact the bacilli would probably have been inactive.

I remember when we first applied the culture test in the diphtheria wards in New York City half of the patients did not have the diphtheria bacilli in the exudate. These patients had been sent to the hospital as a safety measure, because they were suspected of having diphtheria. No one would approve of holding back antitoxin if he suspected diphtheria until the culture results were obtained.

A lot of children get tonsillitis in the wintertime, and some are carriers of diphtheria bacilli which may or may not cause diphtheria. When we make cultures and find diphtherialike bacilli we do not know whether the bacilli are taking an active part. Indeed, from the smears alone we do not even know that these organisms are virulent. From the standpoint of prevention we assume their virulence and declare that the cases are a danger to others and treat them as cases of mild diphtheria.

Last year we limited the children in many schools to two injections of toxin-antitoxin with the idea that it was more practical to give all positively reacting cases only two injections; then, on repeating the Schick test in three months, to reinject the moderate percentage of those who reacted positively, rather than to give all the children the three injections. We found, however, that there was considerable difficulty in getting the Schick retests, and so we have finally settled on giving three injections to all who require protection.

It is interesting to note that while we have been attacking diphtheria from a new angle the mortality has dropped in New York City much below the lowest recorded rate. This year the mortality so far has been the same as last year, but the number of cases has been much less. We consider the showing this year to be very encouraging, as we have had a great increase in measles. We believe this infection caused many cases of diphtheria carriers to develop the diphtheria and also caused some cases of fatal croup that were not diphtheria to be counted as such. We feel so hopeful that we are planning a campaign to immunize as far as possible every child in New York City.

Doctor CUMMING. Doctor Rawlings, what is the population of your State?

Doctor RAWLINGS. A little over 7,000,000.

Doctor CUMMING. Doctor McCoy, will you answer Doctor Rawlings's question?

Doctor McCOY. We took into consideration the question of glassware.

Doctor CUMMING. Is there any further discussion?

Doctor CHESLEY. The very low prevalence of diphtheria fatalities in Washington has been a source of amazement to us. I wonder if the Schick test has given any information to explain this low morbidity.

Doctor MCCORMACK. The Schick test there did show a very large percentage of immunes in Seattle. I do not know anything about the application to the whole State. The rate is very remarkable.

Doctor CUMMING. Doctor Turner would tell you it is the absence of deaths up there in the Puget Sound district. Is there any further discussion?

(No response.)

The next subject on the program, which is "Child hygiene," will be postponed until this afternoon. We will take up, with your permission, the question of "Malaria," Doctor Fricks.

MALARIA.

Doctor FRICKS. Mr. Chairman and members of the conference, it is a pleasant task to discuss the affairs of a going concern at a meeting of the stockholders and their associates; therefore I am pleased indeed to talk to you to-day about our cooperative program for malaria control, which has been unquestionably a very successful business venture looking to health improvement in the South. I am told that this cooperative program for malaria control has returned huge dividends to some of the health officers who have entered into it, particularly in the way of public approval of their activities, and in no State, so far as I know, has it been a liability or hindrance to the State health officer in carrying out his general program for health improvement. I appreciate the fact that not all of you State health officers are directly interested in malaria control, but I feel sure that you are all interested in the successful working of a cooperative agreement such as the Public Health Service, the International Health Board, and the different State health authorities have entered into for malaria control.

Ten years ago governmental, State, and private health agencies began to realize that little was being actively done toward the control of malaria in the United States, although it had been demonstrated conclusively that malaria could be controlled in the Tropics, where presumably the problem was more difficult to handle. Following the methods which had been employed for malaria control in the Tropics, the Public Health Service and the International Health

Board assisting, the various State and local health officials concerned began making demonstrations in urban malaria control at many places in the Southern States. These demonstrations were generally successful, and in most instances the community immediately concerned was highly enthusiastic over the results accomplished.

At this time, however, no definite program for a fixed and permanent policy for continuing and expanding these malaria-control demonstrations was entered into by the cooperating agencies, and although, as before stated, most of these demonstrations were highly successful, they did not lead up to the establishment of permanent programs for malaria control by the different State health authorities. Three years ago such an arrangement was entered into by the cooperating agencies with the health authorities of 10 Southern States. Thus our cooperative program for malaria control was begun, the success of which has been to me most marvelous. Our foundations were sound, of course, because we had been conducting successful demonstrations in urban malaria control for several years. We knew that these could be relied upon. We also had considerable experience in temporary campaign for health improvement conducted by outside agencies in other fields and thereby knew some of the mistakes which must be avoided. It may be that our cooperative program from a business standpoint is a cumbersome arrangement, but we have had no serious difficulty among ourselves in settling the small matters which have come up from time to time. We all see clearly the objective which we have in view—malaria control and the strengthening of the different State health departments engaged in this work. It may be, perhaps, that if we had entered into our cooperative agreement with only one idea in view—that is, malaria control—by traveling alone we might have traveled faster in a sense, at least, but when the greatest good is properly weighed and the largest results are considered, I feel that our policy of helping the State health authorities to graft malaria control onto their general program of health work has proved the wisest and most beneficial in the long run, and I believe that the progress of our cooperative malaria control work during the past three years has demonstrated the wisdom of our policy.

Up to the time that our cooperative agreement was entered into many sporadic attempts at malaria control in the Southern States had been successfully completed, but no State had outlined or adopted a definite program of malaria control. Now every State, possibly except one, that has a malaria problem has also a malaria program with personnel and funds allotted for carrying it out, and no State which entered into the cooperative agreement has taken its "hand from the plow."

In the beginning we realized that cooperative malaria control would be developed along different lines in the different States, because their problems would be somewhat different, and not all of the States had reached the same point of development in their general health work. I have always felt that ultimately malaria control must fit in closely with other rural health work, but it was necessary for us to begin our cooperative malaria work on a basis of urban demonstrations, because previous experience had demonstrated that such demonstrations were feasible, and we were in a position to furnish expert assistance by sanitary engineers who had been trained in work of this character. Hence several of the States found that malaria control could be best conducted under the division of sanitary engineering, while in some States the work has already been placed under the division of rural sanitation.

I shall not take time to enter into the details of our cooperative malaria control work in each State. Some of the State health officers most vitally interested are here and can tell you what is being done in their respective States. I would like to impress you with the fundamental idea of our cooperative agreement, which is that it is the duty of the State health officer to outline the policy and determine the direction under which malaria control should be conducted in his State in order to correlate this work with other health activities and insure its permanency. As an index of the progress which has been made in cooperative malaria control work, I shall give you a very few figures. Upon inquiry we secured records of expenditures for malaria control during 1921 of more than $270,000, which had been locally appropriated. These records are undoubtedly incomplete. This year, 1922, three of the States which are undertaking cooperative malaria control have appropriations or allotments amounting to $10,000 each for malaria control; four States are contributing $5,000 each for malaria control; and two others $2,500 each for malaria control. Thus we have in 1922 from $55,000 to $60,000 set aside by southern States for malaria control, whereas previous to three years ago no State had a definite appropriation for this purpose, so far as I know. Since the cooperative agreement was entered into, three additional States have come into the work—Missouri, Illinois, and Kentucky—so that we now have 13 States interested in malaria control and carrying on a definite program with that end in view. In fact, every State in the Union in which malaria is of sanitary importance is now doing something for its control, except possibly Florida. We have no working agreement with that State, and therefore I do not know what is being done there.

In my judgment, the remarkable success of our cooperative program for malaria control is based upon the fact that there is a widespread demand for malaria control throughout the South, efforts for the control of this disease having lagged behind other health activities in every State. Also, we had our past experiences in other health campaigns to profit by, and have conducted this one on the basis that each party cooperating must contribute something and must carry a definite part of the load.

In addition to supervising the cooperative work of malaria control, the Public Health Service has also conducted certain investigations pertaining to malaria in which you will no doubt be interested. I shall barely mention these investigations, because while they are of greatest importance they are still under way and will be the subject of future reports. One of the subjects under investigation is the importance of malaria on the growth and development of children. I do not believe that this matter has been given the attention in the past which it deserves. Certainly, where malaria infection is heavy the majority of the children are infected quite early in their lives, and heavy infections among children must seriously interfere with their growth and development. A study of malaria among the school children of the South has been undertaken, and in cooperation with Dr. Taliaferro Clark, of the Division of Child Welfare, these studies will be carried on with the care to which they are entitled.

Another investigation in which the service is deeply interested is that of malaria prevalence and malaria reporting. We all realize the inadequacy of our malaria morbidity reports. Most of us appreciate the difficulties encountered in attempting to determine the amount of malaria present in any community by any or all of the methods which have been employed for this purpose. Asst. Surg. K. F. Maxcy of the service has been assigned to the study of this problem, and it is hoped that he may find some fairly easy yet effective method of determining the amount of malaria present in a community.

Another subject still under investigation is that of Paris green as a larvicide. You all know that we have used oil for this purpose since Dr. L. O. Howard first described its use many years ago, but oil has many limitations. Two years ago Dr. M. A. Barber began a series of investigations of larvicides for the service. Doctor Barber soon found that Paris green in extremely minute doses was a very effective anopheline larvicide. There is no question whatever as to the killing effect of Paris green on mosquito larvae in very minute doses, but Doctor Barber is continuing his investigations for the purpose of determining the most effective manner of using or distributing this poison. His investigations have already been reported, and future findings will be brought to your attention through service publications.

I thank you.

Doctor CUMMING. Mr. Fisher will speak on "Methods of evaluation of results of local measures for the control of malaria."

(Mr. Fisher thereupon read his paper.)

METHODS OF EVALUATION OF RESULTS OF LOCAL MEASURES FOR THE CONTROL OF MALARIA.

Before attempting to discuss the methods for evaluating the results of local measures for the control of malaria, let us examine briefly why there should be any evaluation of such results.

The first reason for evaluating results or for measuring accomplishments comes from the desire to know whether the results attained are commensurate with the effort expended. To answer this question it is necessary to have rather a clear understanding of what is included under the designation of results. By effort expended we mean voluntary effort as well as paid effort. In malaria control work, perhaps more than in some other lines of health work, the financial value has come to be emphasized more than the humanitarian value. Whether this is fortunate or unfortunate is a moot question. In this highly commercialized age it would be very difficult in some quarters to inspire any work on humanitarian grounds alone if there were no financial reasons to urge. However, in considering results accomplished we can not afford to lose sight of the humanitarian results.

In considering both the financial and the humanitarian results we must bear in mind that there are direct and indirect benefits of malaria-control work and that the indirect benefits are none the less real because they are indirect.

It is perhaps needless to say that any measuring of accomplishments should be unprejudiced. It is well also to remember that many results are difficult of measurement because we have no well-adapted measuring stick. This difficulty accounts perhaps in great part for the tendency of measuring all results in malaria-control work by the yardstick bearing the dollar mark. This measure is at least one in frequent daily and widespread use, and on that account more readily understood than some other methods might be. Such results as can be stated in terms of dollars and cents, therefore, should be so stated because they will be perhaps more widely understood than if stated differently. People appreciate money, it seems to me, even more than they appreciate life. You can prate about so-and-so many lives saved as a result of your work and you will favorably impress a small group of sympathetic hearers, but when you speak of thousands of dollars saved you get a far wider hearing.

Moreover, because malaria does not kill as many as it temporarily incapacitates the results of such incapacitating, if economically expressed in money losses, appeal to a larger number of people.

If we examine the results of malaria-control measures, we find that there are both direct and indirect results. Some of them are difficult of measurement. This is true of the direct results as well as of the indirect results. Some it is impossible to measure in dollars and cents.

Among the results to be considered and methods of evaluating them may be mentioned—

1. A marked decrease in the number of malaria cases, resulting in an economic saving due to the saving in—

(*a*) The sum spent for drugs.

(*b*) The sum paid for doctors' or nurses' fees.

(*c*) The sum lost because of inability to engage in productive labor.

2. There is a decrease in the malaria death rate resulting for each death in a saving equal to—

(*d*) The same saving as accrues for the preventor of a case of malaria, plus

(*e*) A sum representing the economic value of a human life.

The best method of arriving at these figures is probably by a house-to-house census. If the community is large, it may not be feasible to go to every house. In such a case districts should be selected representative of the whole population and a census made in these, assuming that the figures so obtained bear the same relation to the true total figures as the population canvassed bears to the total population of the town. This census may include figures for the preceding year. But such figures will be less exact than figures for the current year, because one remembers more vividly what happened this year than last.

There are, of course, a number of objections to taking a census in this way. Possibly the chief one is the ignorance and suspicion encountered among certain elements of the population, tending to produce untrue results. If the census is taken by a stranger, the persons questioned may resent what they may regard as a prying into personal affairs. The same objection arises sometimes when the census is taken by an acquaintance or a native of the town.

It is important in gathering and compiling information that it be obtained in the same way before and after measures are undertaken. This is advisable in order that such errors as are made the first time may be made the second time in the same way, thus compensating each other. In this way the results will be comparable; otherwise they will not.

Still another objection to this method of obtaining information with reference to the former and the present prevalence of malaria is due to its inaccuracy. It should be remembered in this connection, however, that there is no absolute accuracy in any method of obtaining information. If blood examinations were made of every person in the community before the control measures were instituted and again afterwards, they would not be absolutely accurate. We must, therefore, be satisfied with a method that is—

(1) Feasible.

(2) Gives comparable results.

(3) Insufficiently accurate for the purpose intended.

It should be noted that the purpose for which the figures are intended have much to do with the method of obtaining the figures. There are occasions when the most accurate investigations, carried out by the most careful and most skilled observers, are justified. But the instances in which such methods should be employed in evaluating the results of local measures for the control of malaria are rare because of the expense involved.

Frequently the results will be used to obtain appropriations with which to maintain work already done. In dealing with appropriating bodies, the facts should be so stated as to be clearly comprehended and so as to admit of no misconstruing, either willful or unintentional.

The whole-hearted statement of the mayor or some other prominent person in a neighboring town giving his valuation of the work carried out in his own town will have more weight with a council considering the advisability of making a first appropriation than a compilation of the results of blood examinations. Similar statements obtained from physicians with reference to the effectiveness of control measures are of great value. Such statements are regarded as coming from expert witnesses. Sometimes the witness is not entirely unprejudiced and its statement is affected accordingly. I have heard some statements coming from enthusiastic physicians which I found it difficult to believe. On the other hand, I heard some which were plain untruths. The latter kind of statement we usually try to disprove because it hurts the work. We don't say much about the other kind.

3. As a third result there is the increased property value accruing because of the removal of the health menace and of the mosquito nuisance. This is measured in increased rental value and is difficult to establish.

4. Then there is the increased value to property arising from the reclaiming of land for agriculture. Some of this value can be ascertained, because the growing crop where formerly mosquitoes developed can be evaluated. This increased value is sometimes estimated by real estate dealers, landowners, or by the property owners themselves. It not infrequently amounts to more than was actually spent on the whole undertaking. The question arises, "Why, if there is such an obvious material gain, was the work not undertaken sooner?" I think there are several reasons. One undoubtedly is due to a trait frequently found in human nature whereby we are loath to contribute willfully to an effort in which our neighbor benefits more than we do, particularly if we believe that our neighbor has a reputation for being stingy or if we think that he has in some way offended us in the past.

Second, it requires a certain amount of time and effort to work out a program that includes the whole community, and frequently the community does not contain the individual sufficiently altruistic, sufficiently patient and long-suffering to endure all the scathing statements with reference to the ulterior motives said to be actuating him to carry the work to completion.

Again, legal obstacles may exist which community enterprise unassisted can not surmount.

I believe that along these lines lies the State's greatest opportunity to reduce malaria, since the appeal can be made to agricultural improvement as well as to health advancement. The work will be largely self-sustaining, in that much of the cost of eliminating malaria will be charged to agricultural development.

5. Among the indirect results which accrue and which are difficult of evaluation but are of great value to the community is the reputation for healthfulness and for progressiveness which comes to the community because of the control measures it carries out. The health authorities should perhaps not be called upon to measure this benefit. Rather it should be worked out by some civic or commercial organization, such as the civic league or chamber of commerce.

Instances have come to our attention where civic development utterly impossible without control measures have immediately taken place after the control measures were successfully instituted.

6. Another important indirect result comes from the savings arising because of increased bodily resistance to other diseases. This is comparable to the like indirect gain resulting to a community when water-borne typhoid fever prevailed until the installation of a safe water supply put a stop to the recurring epidemics. In the case of typhoid fever it is pretty well established that the general death rate is reduced. Is it also true when malaria control measures are instituted? It is logical to believe that in the case of malaria the results will be more noticeable than in the case of typhoid fever.

Before this effect can be measured we must have vital statistics covering a number of communities over a period of years. I do not know of any such statistics now being collected. I think the subject is worthy of study.

Still other indirect gains arise from various lines of increased productivity made possible by full-time labor and more efficient labor. Some of these gains can be measured, others are practically impossible of evaluation. Briefly enumerated they are:

1. Increased production of manufactured goods.
2. Cheaper production of manufactured goods.

Various ways in which the community is benefited thereby are: (*a*) More profit for merchants because of larger volume of goods handled; (*b*) more freight for railroads; (*c*) more discounts for bankers; (*d*) more employment of labor to handle goods; (*e*) better opportunities for professional men; (*f*) more days at school for children; (*g*) better roads, due to better drainage; (*h*) better schools because more tenable property is available; and so on. The enumeration is almost endless.

3. Lastly there results a community spirit of cooperation which makes possible community undertakings previously not thought of. This is particularly true in matters pertaining to public health. "The fly problem must be solved next. If we can eliminate mosquitoes" reasons the community, "why not flies." As a result the town is cleaned up. The health department is revivified. A new spirit is abroad.

To measure these results accurately is difficult, but we know they exist and they contribute tremendously to the good will of the State and Federal health organizations outside of the community that have made the work possible.

In summing up, I should enumerate the methods of evaluation of results of local measures for the control of malaria.

1. A history index made by as intelligent workers as are available, showing essentially:

Location of house.
Number of cases in the family, this year, last year.
Length of residence in the community.
Previous history of malaria.
Economic loss due to drugs, fees, lost time.

This index to be prepared both before any measures are undertaken and about a year later, and again during the following year.

2. Definite statements from physicians with reference to the reduction of malaria cases in their own practice.

3. General statements from leaders in the community with reference to their own observations both as to the amount of malaria and as to the value of measures instituted.

4. Statements from civic or commercial organizations who have studied the effect of the measures carried out.

5. Point out towns which are spending money yearly on maintenance work in order that there may not be a recurrence to former conditions.

Doctor CUMMING. Doctor Ferrell, would you like to discuss Mr. Fisher's paper?

Doctor FERRELL. It is probably not in order for me to attempt to discuss these papers, because the State health officers under whose general supervision the work has been conducted are present and are well qualified to present the facts. Moreover, Doctor Fricks, who devotes his entire time to the malaria work, has presented a most interesting account of the activities.

Two points occur to me which should be of general interest. One relates to the demonstrated feasibility of three or more agencies cooperating harmoniously in a common task. In the Southern States during the past three years the Public Health Service, State boards of health, selected counties and towns, and the International Health Board have worked in complete harmony and through joint effort have made gratifying progress in controlling malaria.

The second point was touched upon by Mr. Fisher. All executives responsible to the taxpayers and legislative bodies are interested in the development of methods for determining the public health importance of a given disease at a given time, the progress made in its control, and the cost of obtaining control. Evidence which is more tangible than is general opinion should be collected. The gentlemen from Virginia and North Carolina have presented figures for measuring results which should have suggestive value. It may not be feasible to collect accurate information for the entire work, but it should be practicable to collect definite information for sample areas.

It has been a satisfaction to me as a representative of the International Health Board to work with the Federal, State, and local health officers who are responsible for the gratifying progress that has been made in this field.

Doctor CUMMING. I think that Alabama has done more than any one State, from what I hear, during the last few years. We shall all be glad to hear from Doctor Welch.

Doctor WELCH. I want to show you by these charts what I think is very largely true of the entire Southern States. The South stands convicted of having malaria, typhoid fever, and hookworm disease. We have pleaded guilty to the indictment and have gone about removing the stigma in a systematic manner. This chart shows the distribution of deaths in Alabama in 1917 before any work was undertaken.

This chart shows the number of deaths for 1921.

You will observe that there are 530 red dots on the 1917 chart. There are 231 on the 1921 chart. In the hill counties of Alabama there is practically no malaria now. It has been expelled in the last few years. There are still areas of heavy infection along our river fronts and in the swampy areas of the State. You will observe by this chart the area of heavy infection. We are attacking these strategic points on the theory that if we expel malaria from these heavily infected areas there will be a tendency for it to disappear from natural causes in the other sections. Malaria is coming rapidly under control in Alabama, and we believe that in a few years we will have come out from under this handicap under which we have labored for the last century.

I will say to the smiling cynics before me that the State board of health did have a part in lowering the death rate in Alabama from malaria. It is at least getting the credit for it down there.

In my opinion, the chief factor in this rapid reduction is due to the fact that during the war, at Muscle Shoals, Camp Sheridan, and Camp McClellan, the United States Public Health Service did some very effective malaria-control work. In 1916 the impounded waters of Lock 12 on the Coosa River were stocked with top feeding minnows, and from this center they have been distributed to the streams all over the State.

Discussing the other problems of the South, I have here an interesting chart which comes to me from my predecessor. A laborer came to this sawmill camp infected with typhoid fever. The stools were thrown into this marsh, which communicated with this creek. The water in the well which supplied the sawmill was exhausted. A ditch was cut to the creek and the water from it conveyed to the well. Three-fourths of the hands working at the sawmill went down within three weeks with typhoid fever, and one-fourth of those infected died.

We have a splendid system of control of municipal water supplies. As a result of that control there were 989 deaths from typhoid fever in 1917 and only 372 in 1921. This work I am showing graphically is the character of work being done by all the boards of health in the Southern States. We have accepted our problems. When we have successfully solved our malaria, typhoid, and hookworm problems, as we surely will, our health problems will then not differ from those of other parts of the United States and the South will come into her own again.

Doctor CUMMING. Doctor McCormack, of Kentucky.

Doctor McCORMACK. I am rather inclined to think that in the long run those of us in the malaria and hookworm and rather large typhoid fever area of the United States will be very fortunate, because it is much easier for us to demonstrate to our people rapid and marked progress than it is in the sections that are so unfortunate as not to have these dramatic diseases, and therefore we are able to secure a degree of public confidence rather more rapidly than they are able to furnish us with money.

Having been in some 25 States during the past year, I have been impressed with the tremendous progress that is being made to-day by the health organizations of the United States. It seems to me that it is of the utmost importance that we formulate our plans for the State, so as to do our job better every day, and that in the increasing personnel that is being demanded by the people we develop that personnel so that it is competent and delivers the goods in its individual unit in practically every instance. We can not afford to make a mistake. We can not afford to furnish through these people incompetent health officials and accept the responsibility for them. We must build our agencies, if necessary, rather slowly to meet the popular demand.

The cooperation between the United States Public Health Service and the States and the localities seems to me to be the most important prospective development of the future. At the recently adjourned conference of State health authorities I do not think anything more important was considered than the memorial to the Congress thanking them for the Federal aid which has been extended to the States where great progress has been made, but requesting Congress and the Executive to study the entire health problem presented in these United States and to formulate such a general plan of coordination and cooperation as will assist in stimulating the development of some sort of competent local health agency that will be available for every citizen and every resident in the United States. Our plan should be developed broadly, and I believe it is important for us to come in contact with Senators and Congressmen. They are always glad to have us and have our advice. They know very little about these special problems unless they get that information from one of us, and we have been rather backward sometimes, it seems to me, in going to our statesmen whose first desire naturally is to take care of the people who elect them to office.

We have been a little remiss, I suspect, in giving to them the information which we have which would be of enormous interest and value to them if it were presented to them by those of us in whom they have confidence. Of course, if you do not know your Congressmen and Senators, if they do not believe in you, it is better for you not to talk to them; but if they do, and you have not charged them with the knowledge that you have, it seems to me that in that way you are derelict in a big part of your duty.

In recent conferences in various parts of the country public-health nurses who were acquainted with representatives in the State legislature talked to them about health and their social problems. I want to say that if you have not talked to your Senators and Representatives, and if you have not talked to your representatives in the assembly of the State, it is just like trying to write on blank paper with a pencil without a point. It is important for us to take our movement forward very rapidly if we are going to make real progress. I want to appeal to the health officers of this country to feel the tremendous responsibility, not alone for the scientific, patriotic, and statesmanlike work that we are doing from our offices but for making the right impression on the public. That is our first responsibility, and unless we do take an active interest in it we can not make progress as rapidly as we desire. On the other hand, we must not get too far away from our load. I like to remember our country fellows. If you hitch your team too far from the load, you either break the traces or stall the team. You do not want to get too far ahead of public opinion, but you should keep on educating public opinion so it keeps up with you; but be sure to educate legislative opinion so it keeps up also. The most important result of such a conference is not only the mutual acquaintanceship, the general rivalry stimulated by such a demonstration as this health officer from Alabama suggested, but confidence in one another and mutual knowledge that the problem that confronts any of us in any State in the Union is the problem of every health officer. We must make the Congress help us build an organization that will make the United States the healthiest, happiest, and best nation in the world.

In Portland I was speaking to a city club that made a remarkable study in cooperation with the service of sanitary conditions in Portland. I spoke that day on the same program with the president of the University of Bombay, and in his opening remarks he said that he represented an institution that had existed continuously for 7,000 years. It made us feel very young. At the end of 7,000 years I would like to see America a nation whose destinies were not presided over by some foreign potentate; I would like to see America still have its place in the sun and still helping to control the destinies of mankind. If we are to do that, we must train our whole citizenship.

Doctor **Cumming**. If I had time, I would get Doctor McCormack to tell you what the chairman of the Appropriations Committee told him. Doctor Fulton will now talk to you about the registration area for morbidity.

REGISTRATION AREA FOR MORBIDITY.

Doctor **Fulton**. The Surgeon General's office and the delegates to this conference have been patient and considerate toward me during six or seven years past. Nearly every year I have summarized the morbidity reports turned in by the States and cities to the Surgeon General's office in such fashion as to indicate the order of merit of so many attempts on the part of 34 States to inform themselves about current morbidity.

Each year I have proposed the formation of a registration area for morbidity to be located in the United States Public Health Service of the Treasury Department.

During the last five years I have considered it quite feasible to create such a registration area, the conditions being, in my judgment, quite as favorable as the conditions under which the United States registration area for mortality was created in consequence of an act of Congress passed in 1902 and giving us, in 1906, a first volume of mortality statistics, covering the annual mortality for four years (1900–1904) in an area comprising only 11 States and a number of cities in nonregistration States.

The creation of a registration area for births (1915) was effected under conditions less favorable than the Treasury Department now confronts in planning a registration area for morbidity.

The Surgeon General's office is not destitute of knowledge concerning current morbidity. It does not receive this information in such a way nor has the office internal arrangements or personnel sufficient to produce annual publications of the kind we are familiar with in accounting for births and deaths.

I sincerely hope that the conference will not adjourn without placing as heavy a load as the delegates present can reasonably impose upon the Surgeon General's office concerning this project and that everyone will get behind the Surgeon General. He may have space and personnel, though I doubt it. Certainly he will need additional funds.

Finally, remember this, that the conference, in assenting to delay, willingly or unwillingly delays the project not for a year but for two years. When authority and means are at length provided we shall wait at least 18 months for a first report of the Surgeon General on the registration area for morbidity.

Doctor CUMMING. Doctor Warren.

Doctor WARREN. The Public Health Service has, as Doctor Fulton knows, been endeavoring to get appropriations for six or seven years to start the registration area for morbidity. During the war everything went for the war; there was no extra money except for war purposes. Since the war there has been economy, but I believe that during the coming year or so the Congress will let us have some appropriations for this purpose.

The Congress has placed these appropriations back on a pre-war basis, and that is where we are now, without any funds; but the Public Health Service has endeavored to assist in this line in getting better morbidity reporting by means at hand. For example, there are now only four States east of the Mississippi River and two States west of the Mississippi River without collaborating epidemiologists of the Public Health Service. The number in the States is gradually increasing. We now have between four and five thousand collaborating and assistant epidemiologists; and if you will notice morbidity reports, they have been increased over 100 per cent in the last six or seven years, or more than that.

In regard to doing something without funds, we thought at one time, after the last conference, that we would start something in the way of getting at the morbidity by means of the weekly morbidity occurring in 100 cities in the United States. We sent out letters to the State health officers with that in view. We realized that to get these morbidity reports promptly we would have to in a way get the reports direct from the cities. We put up to them, owing to the urgency of getting a quick report, the question of having the cities send us a telegram every Monday morning and mail a copy of that telegram to the State health officer, but it did not get their approval. I do not blame the State health officers. From their viewpoint it was not the best policy, and so we let it go at that. So many of them objected to it that we decided not to push it any further. We do receive on Monday and Tuesday of each week telegrams of the reports from quite a number of States.

The following is a list of States showing they have reported for the 17 weeks of this year:

Alabama has reported on time 16 times, 1 time late; Arizona has made no report; Arkansas has reported all reports on time; California, all reports on time; Colorado, on time 16 times, 1 time late; Connecticut, all reports on time; Delaware, 14 times on time, 1 time late, and 2 reports not received; District of Columbia, 17 times late; Florida, all reports on time; Georgia, all reports on time; Idaho, no report; Illinois, all reports on time; Indiana, all reports on time; Iowa, all reports on time; Kentucky, 17 times late; Louisiana, 16 times on time and 1 time late; Maine, 12 on time and 5 late; Maryland, all reports on time; Massachusetts, all reports on time; Michigan, no reports; Minnesota, all reports on time; Mississippi, all reports on time; Missouri, all reports on time; Montana, all reports on time; Nebraska, all reports on time; New Jersey, all reports on time; New Mexico, all reports on time; New York, all reports on time; North Carolina, all reports on time; North Dakota, no report; Ohio, no report; Oregon, all reports on time; South Carolina, no report; South Dakota, all reports on time; Texas, all reports on time; Vermont, all reports on time; Virginia, 9 reports on time, 8 reports not received; Washington, all reports on time; West Virginia, 16 reports on time and 1 time late; Wisconsin, all reports on time; Wyoming, only 2 reports received.

Of course, the morbidity reports, as received, are not satisfactory, but it shows the State health officers are trying to cooperate and send us what they have, and we publish those reports, if they are received on time.

In connection with the obligations to collect morbidity reports, which have been imposed upon the Public Health Service by acts of Congress and treaty obligations, the following letter of the Surgeon General is published as explaining in full his position in this regard:

JUNE 22, 1922.

Dr. A. J. CHESLEY,
Secretary State Board of Health, St. Paul, Minn.

DEAR DOCTOR CHESLEY: I wish to acknowledge the receipt of your letter of June 14, relative to the collection of morbidity reports by the Public Health

Service from the cities of the United States. I have before me the resolution adopted by the thirty-seventh annual meeting of the Conference of State and Provincial Health Authorities of North America, relative to this subject.

In a general way, I may say that I agree with the principles contained in the resolution relative to State health work, but it did not occur to me at the time I agreed to the resolution of the State health officers that the Public Health Service has certain duties to perform under the acts of Congress which do not relate to State health work, such, for example, as national quarantine, prevention of interstate spread of certain diseases, and the carrying out of treaty obligations of the United States. In performing these functions, however, I wish it clearly understood that it is my desire at all times to execute these duties in cooperation with State and local health authorities. I realize that it is by teamwork that the health protection of the citizens of the United States can best be accomplished.

Occasionally in the history of the Public Health Service questions as to the methods of cooperation with State and local health authorities have been brought to the attention of the bureau by resolution or otherwise. In many instances, as in this resolution, those who drafted the resolutions did not have the background of knowledge or experience as to the duties and obligations of the service under the acts of Congress.

The act of February 15, 1893, provides, among other things, as follows:

"* * * and the Secretary of the Treasury shall also obtain through all sources accessible, including State and municipal sanitary authorities throughout the United States, weekly reports of the sanitary conditions of ports and places within the United States, and shall prepare, publish, and transmit to collectors of customs and to State and municipal health officers and other sanitarians weekly abstracts of the consular sanitary reports and other pertinent information received by him, * * *."

Under the international sanitary convention signed at Paris January 17, 1912, the United States obligates itself to furnish to the other powers signatory to the treaty information as to the sanitary conditions in the United States. You can readily understand, therefore, that the collection of morbidity reports is a Federal obligation, as well as a State and local one. As a Federal obligation it has nothing to do with the police powers of the State and is not an interference on the part of the Federal Government in the State police powers, and is clearly within the duties which might be expected of the United States, especially in its relations with foreign countries.

The Public Health Service has been receiving these reports from the cities as far back as 1888. The reports, of course, were very meager at that time, but they have been increasing in volume and improving in reliability until at the present time, out of 755 cities in the United States with a population of 10,000 or more, the Public Health Service is receiving regular reports from 264 cities and fairly satisfactory reports from 291 other cities, or a total of 555. These reports are published weekly in the Public Health Reports and the annual reports received from these cities are published annually. I am inclosing a copy of the Public Health Reports for June 9, 1922. By reference to that report you will find the annual report for cities of 100,000 population and over, covering some 20 pages. In the same report you will find the weekly city reports for the week ended May 20, 1922, covering 12 pages. A further reference to this issue will show you a weekly report received from the States. This covers five pages. In the same issue you will find the Health Index compiled each week by the Census Bureau from the city reports. I understand that the Census Bureau in establishing its registration area for mortality reports does not always work through State health departments.

In collecting the morbidity reports from cities, the Public Health Service desires to obtain three classes of information:

1. The number of cases of communicable diseases reported to the city authorities each week.
2. The number of deaths from the communicable diseases reported.
3. The number of deaths from all causes.

For your information I am inclosing a card used by the service for this purpose, a supply of which is sent to all of the cities in the United States of 10,000 population or over. These cards, when filled out by the city health authorities, are sent directly to the Public Health Service. Up to the present time there has been very little complaint on the part of the State that such reports interfere with reports of the same cities to the State departments of health. When such complaints come from the State departments of health to the Public Health Service, they are informed as to the purpose of these reports. In such cases the State departments of health are also informed that cities in the said States would be advised to discontinue such reports to the Public Health Service, provided the State departments of health could furnish the same information as promptly and as accurately as the information received from the cities, thus enabling the Public Health Service to perform its duties under the law and carry out the treaty obligations of the United States in regard to international sanitary agreements.

Up to the present time three States have agreed to furnish the desired information from cities within their jurisdictions. These three States, however, have not up to the present time succeeded in furnishing the information as desired. One difficulty which seems to lie in the way of the States furnishing this information promptly and accurately is the fact that the death reports do not appear to be available for insertion on the card. Another difficulty is that in the rush of other work in the State department of health there results a considerable delay, especially in times of an epidemic, when the information is particularly desired.

Recently a certain State department of health made a complaint similar to yours, but when advised as to the character of the information desired, the secretary of the State board of health withdrew his objections.

If Minnesota is able to furnish the information desired of all the cities in its jurisdiction of 10,000 population and over, the Public Health Service will be glad to collect this information through your office, but you can readily see that under the act quoted above the Public Health Service is commanded by the Congress to obtain this information through all sources accessible, including State and municipal sanitary authorities. Where States are willing and able to furnish the information required under the law, it is a much more desirable method of collection. But where States are unwilling or unable to furnish the information, it is a mandate of Congress to the Public Health Service to seek to collect this information from municipal sanitary authorities.

Respectfully,

H. S. CUMMING, *Surgeon General.*

Doctor CUMMING. If there is no discussion, we will now take up the topic "Venereal diseases, the proposed program for the ensuing fiscal year."

PROPOSED PROGRAM FOR THE CONTROL OF VENEREAL DISEASES.

Doctor PIERCE. Day before yesterday six of the State venereal-disease control officers were in conference practically all day with me and with other members of the staff of the Venereal Disease Division. The State venereal-disease directors present were from New York, Pennsylvania, Mississippi, New Jersey, Indiana, and North Carolina. That night three State health officers, Doctors Olin, McCormack, and Crumbine, met with us and discussed a program for next year. At this conference we reviewed the work that had been done during the past year and the State programs already in operation. and also discussed in some detail various phases of the program that all of us agreed should be emphasized during the coming year.

In order to carry on any practical program in any State money is required. Most of you know Congress appropriated $225,000 for allotment to State boards of health for venereal-disease control work during the fiscal year beginning July 1, 1922. I am sorry that this amount is not larger, as it figures out a little less than one-fourth of a cent per capita of population. The allotment due each State was printed in Public Health Reports for May 5, 1922. Shortly after you return to your homes you will receive a letter from the Surgeon General setting forth the exact amount to which each State is entitled and the provisions under which it can be obtained. An equal amount must be appropriated or otherwise set aside by the State for expenditure for venereal-disease control work under the direction of the State board of health.

The regulations governing the payment of the allotment will be the same as they have been for the past four years, with a few modifications made necessary by the fact that the appropriation this year was made in the Treasury Department bill and will be handled by the Public Health Service. A plan for paying these allotments to the States was submitted to the Comptroller General of the United States and was approved by his office and by the Secretary of the Treasury. This plan provides that allotments will be paid quarterly in advance. Before the State is paid evidence must be furnished to the Surgeon General that an equal amount of State funds are available, and a budget is to be prepared and forwarded to the Public Health Service showing the manner in which it is propsed to expend the joint fund. State funds in excess of the Federal allotment should not be included in the budget, nor should the expenditure of such funds be reported to the Public Health Service, except as a matter of interest and as evidence of work accomplished by the State.

After the first quarterly installment of the allotment has been paid to a State, all vouchers will be settled by the State and not sent to Washington for payment. A monthly report of disbursements made from the joint fund will be required.

There are three things that can not be bought from the joint venereal-disease control fund—buildings, land, and automobiles—as congressional restrictions apply to the joint fund.

Having disposed of the financial phase of this matter, let us consider briefly the program for next year. The six State venereal-disease control officers and the three State health officers participating in the conference of day before yesterday have practically agreed upon the basic principles of the program for the coming year. Please remember during this discussion that the suggestions made are largely generalities and that the details regarding the application of these principles are left to each State. All of us feel that it will be well worth while to devote considerable thought, energy, intelligence, and supervision to the question of interesting private practitioners throughout the country in venereal-disease control and to endeavor to see that doctors give better treatment to these cases in the future than they have in the past. We believe that 90 per cent of the venereal-disease cases will be treated by general practitioners, not by specialists. This is a condition that we can not change, and therefore we should get the general practitioners to adopt better methods of treatment. We should also impress upon them the importance of the social phase of venereal-disease control to a much greater extent than is appreciated at the present time. By social phase, I refer to ascertaining the sources of infection and efforts to prevent the spread of venereal diseases. Certainly, when a married man or woman or a child is under treatment for a venereal disease the doctor should inquire into the history of the case and examine the other members of the family to bring them under treatment if necessary.

All of us agreed that the work of the divisions of venereal diseases in the various State boards of health should be linked up with the work to be done in your State under the terms of the Sheppard-Towner Act. If you endeavor to prevent infant and maternity mortality and to bring about conditions which will benefit the newborn child, there is no other one activity that plays a larger part in such a program than control of venereal diseases, particularly syphilis. There is a good deal of statistical data available on the relation of syphilis to infant mortality. Such data has been collected by Dr. P. C. Jean, of St. Louis, and Dr. Whitridge Williams, of Baltimore. At the present time a letter is being prepared which will be sent to all State health officers inviting attention to the importance of venereal-disease control in any program to promote infant and maternity welfare. This letter is based on data we have collected and on the opinions of the leading obstetricians of this country. Just how to link up venereal-disease control work with infant and maternity welfare work in the State is something for each health officer to work out for himself. We desire to recommend that you devise some plan to make these two divisions of your State board of health function coordinately.

Another point we all agreed upon was that every effort should be made to develop the venereal-disease control program as a local community responsibility. We want to get each town and county of every State to bear its own financial burden and to provide treatment for infected persons; to carry on preventive work; protective social work; educational work; and all the phases of the program. Each community should be willing to assume its local responsibility in relation to protecting the rest of the community against venereal diseases, just as they do for all other communicable diseases.

The fourth point discussed and upon which we agreed was that we recommend to State health officers that the venereal disease control program should be carried on as nearly as possible in the same general manner that all other communicable disease control programs are conducted. We should not expect to continue indefinitely to make provision for a special agency in each State for venereal disease control. Such work is really a part of the work of the communicable disease bureau or division. During the past four years we were quite justified in making venereal disease control work a special division of the State board of health because the problem had been neglected previously, but we must now look forward to the time when such work will become a part of the bureau of communicable diseases, to the time when gonorrhea and syphilis will be controlled as are other communicable diseases.

I would like to point out that when you agree to this proposition of putting venereal disease control on the same basis as the control of other communicable diseases, more attention must be paid to the sources of infection. When you find a case of smallpox, whether it be in a house of prostitution, in a restaurant, in a hotel, or in the city, you institute proper measures of isolation to prevent any spread of the disease. When these communicable diseases, gonorrhea and syphilis, are handled as other communicable diseases by the health office, it can not be said that suppression of the prostitution is a matter to be handled only by the police and law-enforcement agents. If we treat syphilis and gonorrhea like we treat other diseases, the health department has a great deal to do with the suppression of all forms of prostitution. This does not mean that I advocate raids on houses by the health department. We must, however, see that the proper local authorities perform their duty in regard to destroying foci from which venereal infections spread. Health departments must assume certain responsibilties in connection with eliminating vice conditions in the community if we are going to treat gonorrhea and syphilis like other diseases.

All of us agreed that the educational program carried on for the past four years is a necessary part of venereal disease control work. In fact, at all recent public-health meetings it has been emphasized that public health is a matter of education, and that a well-informed public can avoid not only venereal diseases but all other communicable diseases. We therefore believe that an energetic educational campaign should be continued, but we do feel that the time has come when we can specialize in educational activities in relation to venereal disease more than we have in the past.

I have here some charts which I will show in a few minutes which will illustrate this idea of specialization in educational material for which we must devise certain methods to reach certain groups and have our educational material applicable to that group. Such a plan should increase the percentage of efficiency and reduce the loss of time and material that has undoubtedly occurred in some of the educational work carried on during the past four years.

In considering educational work for venereal disease control we should consider the relation of the educational system of the State to the health department in connection with an educational program among school children. A plan should be worked out by each State so that the various State educational departments will gradually make provision for meeting their responsibility in connection with training children of school age. The State board of health should cooperate in this plan with the educational authorities but should make it clear that ultimately each school system should meet its responsibility in connection with furnishing exhibit material and other facilities for a program of health education in the schools.

In connection with educational work I would like to refer briefly to the institutes and conferences of laywomen that we have had during the past year. Sixteen of the State boards of health have cooperated with the Public Health Service in conducting these public-health institutes. Only two of the institutes were specifically confined to venereal diseases; the others were on general public-health subjects. At these 16 institutes there were registered 1,718 physicians, 1,907 nurses and social workers, 238 students, 107 teachers and clergymen, 69 sanitary engineers, 46 judges and court officials, or an average registration of 391, the total registration being 6,254. The total number of clinics was 135, with a total attendance of 3.205.

We have reached very large audiences through these institutes which were attended not only by local people but by many who traveled considerable distances at their own expense. The registration at each institute is shown in the following table:

New Orleans, La	105
Columbia, S. C	418
Dallas, Tex	285
Birmingham, Ala	252
Memphis, Tenn	299
Louisville, Ky	365
Indianapolis, Ind	822
Pittsburgh, Pa	264
Chicago, Ill	1,001
Minneapolis, Minn	142
Portland, Oreg	180
Kansas City, Kans	478
Spokane, Wash	140
Newark, N. J	589
Albany, N. Y	137
Hartford, Conn	777
Total	6,254

In connection with several of these institutes, and in one or two instances as a separate event, there have been social hygiene conferences for lay women. The first of these conferences was held here in Washington last October, and was attended by 250 women. The next was held in St. Louis, Mo., in December last, and was attended by 400 women. These two conferences were not held in connection with institutes. The following conferences were held concurrently with the institute at the respective cities:

Columbia, S. C	250	Indianapolis, Ind	275
Birmingham, Ala	200	Pittsburgh, Pa	280
Memphis, Tenn	150	Kansas City, Kans	150
Louisville, Ky	270	Newark, N. J	500

The last institute was held in Newark, N. J., on April 19 and 20, and was attended by women who came from all over the State, and they came to this conference for the purpose of learning something in regard to social hygiene or venereal-disease control work.

Doctor Chesley pointed out to you yesterday that these women represent powerful organizations of a tremendous membership, and that they have shown an interest in this phase of public health work and have been a great help to various State boards of health. I cordially recommend that interest of these women be taken into consideration by each State department of health and that their aid be secured for extending the entire State program.

We had hoped to have Dr. Joseph S. Lawrence, director of the venereal-disease work in New York State, follow these remarks of mine by a brief presentation of the work in New York State. Unfortunately, however, Doctor Lawrence had to leave this morning, and is unable to participate in the program. He did, however, leave the charts which he intended to use in his address, and I am going to place these charts here so that anyone interested may examine them. You will find a chart which illustrates the idea of specializing in educational material, to which I referred a few minutes ago.

(As cuts of these charts are not to be printed, the last of Doctor Pierce's remarks will be eliminated, as he spoke entirely in reference to the New York State charts.)

Doctor CUMMING. We will now hear from you, Doctor Snow.

Doctor SNOW. I think it is a valuable report. It gives us a vision of what should be done in the future. I think that all the points which have been made are extremely practical, judging from what I hear of the people's viewpoint as I go about the country. We should do what can be done now to impress Congress with the importance of not cutting off the protective work which the board recommended. I understand the Department of Justice is ready to carry on this work if it is the will of the people that it should go forward. We can show that this is just a flying squadron of specially trained persons to gather accurate information in communities where there are troops, and to stimulate throughout the country similar local agencies for gathering information which given to the proper civil authorities induce them to act. This activity serves as a constant demonstration of what can be done not only in communities near military and naval posts but everywhere.

I hope the efforts of the interdepartmental board to have this work continued will be warmly supported by all of the health officers, because they are in a position to prevent confusion over the issue.

Doctor **Stiles**. It might be interesting for the health officers to know that they have a new convert to the venereal-disease campaign. A few weeks ago I had the pleasure of spending several days in a city of about 35,000 inhabitants. From information which I consider trustworthy, the Ku-Klux Klan in that city numbered 1,200 out of 35,000, and this same Ku-Klux Klan has taken up the venereal disease as part of its regular program. I did not know the Ku-Klux Klan had become interested in public health matters, but it seems to be a fact that in this city they have.

Doctor **Schereschewsky**. There is another topic which we might finish up. It has come into considerable prominence; and that is, the transportation of lepers. Doctor Kelley was to handle that. I will ask Doctor Chesley to say a few words.

TRANSPORTATION OF LEPERS.

Doctor **Chesley**. We are all very much encouraged in relation to the problem of leprosy in the United States. When Congress made an appropriation enabling the Surgeon General to take over the institution at Carville, La., and provide for medical treatment which promises arrest or cure in many cases—also to provide for transportation of cases to the sanatorium—they did a good thing. Several cases have been sent there from Minnesota. Others are willing and anxious to go, but are obliged to wait because of the lack of accommodation. Doubtless every State has a leprosy problem. The health officer may not know about all the cases, but as soon as the people concerned learn that there is a place to which patients may be sent without cost, where they will receive the very best treatment that is known under very comfortable and agreeable circumstances, both patients and their families will be equally desirous of taking advantage of it, and will let the health officer know where the cases are. Then without publicity the patients may be sent and treated if accommodations are provided at the sanatorium, and the leprosy problem will be solved. While leprosy here is a minor proposition, it is of great interest to the public, and, owing to the great injustice which may be done to the individual through lack of treatment and through actual persecution, it deserves consideration out of proportion to its real importance as a public-health problem.

Doctor SCHERESCHEWSKY. Is there any discussion?

Doctor McCORMACK. I would ask why it is not advisable to transfer the lepers to the leper sanatorium on ordinary trains and in an ordinary way. I do not believe it is necessary to unduly alarm people about the transference of these cases, and I think when a leprosy diagnosis is made they should be sent there with a nurse or somebody to go along and see that the ordinary precautions are taken. They should be sent immediately without any publicity; they have been traveling in this country for the last hundred years and have not increased the leprosy except by an importation, and I think we will decrease it by sending them to the leprosarium rapidly. It is an additional expense to send them in a private car, and I believe it gives the wrong idea anyhow.

A MEMBER. Has there been any recent ruling with regard to interstate transportation.

Doctor SCHERESCHEWSKY. The most recent statement in regard to that is contained in the revised interstate quarantine amendment. There has been no modification made in the amendment. In the case of a disease like leprosy you are dealing with a prejudice of the public. It will take some years to remove that fixed impresison of the public.

What Doctor McCormack advocates would be eminently desirable but would require education on the part of the public before they would consent to let you give ordinary transportation to a leper. Now they usually have a car to themselves. We try to get a tourist car and give them the whole car, and after that the popular prejudice is that the car company will have to renovate it. That is nonsensical but that is a fact. They might as well scrap that car.

Doctor McCORMACK. I think that is absolutely absurd; the thing to do is to buy the fellow a ticket and send him down there, not saying anything about it. I think he ought to be shipped, and I think we ought to do it. I think we are rather excited and keep it going on, and I believe we ought to be spending the money that we spend for a private car for sensible things.

I think that statements should be given out through the radio system so the people will understand that leprosy transported is as little dangerous as any other disease. We should ship him like he has been traveling all the time.

We are finding some cases because we are really going after it. I would rather spend the money for buying those fellows something to eat instead of paying for tourist cars.

Doctor WELCH. There has not been a year in the last four or five years in which there has not been on the Gulf of Mexico an imported case of yellow fever. The health officers in whose jurisdiction that yellow fever occurred has notified all the State health officers immediately contiguous to him. In my case, when the notice came, I notified my governor that there was a case of yellow fever in a neighboring State, and that was the end of it. I have always told the newspaper reporters of the city of Montgomery and requested them not to put it in the papers, as there was no danger. I promised if there was any danger we would notify the public.

The last case which appeared on the Gulf coast died. The body was shipped to relatives in California.

I think we should teach the general public that there is no special cause for alarm in the transportation of lepers. I think we should teach them that there is no reason why those who are not lepers should be robbed of their good money to satisfy an unreasonable and unreasoning fear on the part of hysterical people.

Doctor STILES. The present prejudice against leprosy is unquestionably due to the attitude of the Bible on leprosy. We are out of sympathy with that attitude, but we have to face the fact that the churches of the country have been preaching the terrible effect of leprosy from the year 1 down to the present time.

If the health authorities overcome that influence we are going to waste a lot of time. It is a good deal easier to do it in another way. Let us recall that a car carrying a case of leprosy might be interpreted as a life-saving device and might have free passage. It would be a simple matter to have a car, such as a laboratory car, as a life-saving device transport patients under the provision of the interstate law which gives to a life-saving device free transportation. That is a possible way out of it if it is a question of money, but as far as going against the present prejudice of the country, due undoubtedly to the pulpit and the Bible respecting leprosy, we are going to take hold of a great big piece of cake that we can't bite off.

Doctor McCORMACK. I believe every word the Bible says about it, literally and absolutely. I have as much prejudice in favor of the Bible as any man. All the same, I do not believe, in these United States of America, that the interpretation of the laws laid down handling leprosy in Palestine applies to modern conditions; and if we had unlimited funds it would still be wrong for us to waste a dollar in any such foolish proposition as paying for transportation of lepers in a private car. I think it is a matter of principle that we ought not to be guilty of the thing, and I do not believe that the churches and the pulpits would hesitate to agree to that. If we bought the lepers tickets and sent them, nobody would ever know it.

Doctor FULTON. I do not think the railroad company is entitled to notification of the moving of a leper. The way to move him is to move him. He will go through all right. Nobody will find it out.

The leper should not go unattended, but passengers do not have to know all about it.

Doctor LUMSDEN. Positive statements in regard to the degree of danger from association with lepers might be encouraging if we could be sure they were true. We do not know how the infection is spread. We do not know the period of incubation. So far as we know, years may elapse between the time of infection and the time of manifestation of the disease in some cases. In view of our state of ignorance about leprosy, I think that we as health officers would be subject to criticism if we advocated and put into practice the surreptitious transportation of lepers by common carriers. I doubt that any one of us here this morning would be willing to sleep under the same blankets that we knew a person with well developed leprosy had slept under the night before. I would not.

I think a thorough epidemiological study should be made of leprosy in the United States. We are finding more and more cases since the national leprosarium was established. They are coming to light. The disease appears to be spreading slowly but surely in some sections of this country. Recently, while on a visit to one of our small cities on the Gulf of Mexico, I had my attention called by the local health officer to a case of leprosy in a man who was living in a thickly built-up section. A number of men, women, and children were closely associated with that leper. Arrangements were made for the transportation of the man to the national leprosarium. Within the two weeks following, the local health officer discovered three other cases in that city. Two of the cases were in brothers who were attending a high school. Their father ran a restaurant and the boys worked in the restaurant from time to time. I think we should learn more about leprosy than we yet know before we sanction or advocate the transportation of lepers without reasonably rigid sanitary precautions.

Doctor SCHERESCHEWSKY. The hour is now very late, and we want to get through. It seems that a motion to adjourn would be in order.

A MEMBER. I move that we adjourn until 2.15.

(A recess was taken until 2.15 o'clock of the same day.)

AFTERNOON SESSION, MAY 18, 1922.

Doctor SCHERESCHEWSKY. The meeting will be in order, please. We still have one subject from the morning program before we pass to the general subject of child hygiene, and I think we should have a short discussion, and that is the question of uniform parole system.

Doctor Trotter has had a good deal of experience in that, and I think it would be proper for him to say a few words before we go on to the subject of child hygiene.

Doctor TROTTER. In order that you may understand the parole system in force in Hawaii a statement of the arrangement between the United States Public Health Service and the Territorial board of health is necessary.

Kalihi Hospital is operated and maintained by the Territorial board of health, while the medical attendance is furnished by officers of the United States Public Health Service. In order to have free access to the clinical material available for research work an agreement was made by the United States Public Health Service and the Territorial board of health whereby the latter furnished suitable buildings for laboratory work and other purposes for the Public Health Bureau and allowed them the use of the hospital and all patients for research work on leprosy.

In other words the medical service is furnished by the United States Public Health Service while the administration and operation of the hospital is under a superintendent appointed by the board of health. This arrangement has been in effect for some years and has been satisfactory to all concerned.

The paroling of patients being a purely administrative measure, is under the authority of the board of health, though it is necessary for the Public Health Service officer in charge of the medical work to inform the board of health when any patients are considered fit for parole. There is no prescribed rule as to the length of time a patient must be held in the hospital before he is eligible for parole. The progress of the case must be such that the medical officer deems the patient able to return to his home without becoming a menace to the public. Under such conditions the medical officer reports to the board of health that such patients are fit subjects for parole. The president of the board of health then appoints a board of three physicians, who examine the patients, clinically (and bacteriologically if desired), and also their records while in the hospital. If a majority of the board find that, in their opinion, the patient can be paroled without being a menace to the public, they recommend that he be paroled, subject to certain conditions. The board of health at a regular meeting receives these recommendations of the parole board and puts into effect the recommendation of the board.

The conditions of the paroles are varied according to the conditions applicable to each case. All paroled patients are required to report to the hospital or to some representative of the board of health at intervals for observation. Many cases are required to report weekly, others monthly, some quarterly, and a few semiannually. After a period of a year or more the reporting period may be lengthened by the board of health in its discretion. After a period of years, usually four years or upward, if the patient has shown no evidence of active leprosy, application may be made to the board of health for a release from parole. A board of three physicians is appointed to reexamine the patient; and if found free of evidence of active disease, release is recommended and later granted by the board of health.

The board of health has come in for some criticism for paroling patients from Kalihi Hospital under the procedure as outlined above, as there have been a certain number of recurrences of the disease, with the result that some parolers have been readmitted to Kalihi Hospital, but in my opinion the paroling of these patients at this time was one of the best actions that the board of health has ever taken. This is because of the fact that the paroled patients returned to their homes on the various islands and were an object lesson to other persons residing in the district.

By reason of the paroling of such a number the board of health has gained the confidence of the people, and we are having patients come voluntarily and surrender themselves, and particularly so are parents sending in their children in the early stages of the disease, which is something that has never happened in the history of leprosy in Hawaii. We feel that having these children come in the early stages is most encouraging, for we believe that with the treatment now in use the disease can be arrested in them, and they can later return to their homes.

The Kalihi Hospital receiving station is on the outskirts of Honolulu, 10 minutes' automobile ride from the city. To-day we have, I think, 185 patients in this hospital. We have not made any transfers to Molokai since 1919. There is a 4-foot iron fence in front of it, and two employees guard it during the night to keep the buildings from burning down, but not to keep the patients in. That station is under a dual control. The attending physician is Doctor Hasseltine. He has charge of the medical work in connection with the station, while the routine administration is carried on by a most exceptional Hawaiian woman superintendent. She has been there for a little over three years, and in all that time the board of health has never received a complaint in connection with the institution, which I think is, considering the number of patients we have, a remarkable record.

So far as the medical treatment of the patients goes in the institution we leave that solely to the attending physician. We make no change at all in the treatment or any routine administration, except with his consent. It has worked out most satisfactorily, and we are grateful, indeed, to have a doctor of the ability, and one who has shown himself to take such an interest in the work, as has Doctor Hasseltine, of the United States Public Health Service.

Doctor SCHERESCHEWSKY. Is there any discussion on the subject?

Doctor GARRISON. I just want to get a little information. Some two or three weeks ago there was a case of a leper who came to Little Rock—a lady from a well-to-do family from Kansas City.

According to the history submitted to me, she had never been outside of the United States, had never been exposed to leprosy, and, according to a very good bacteriologist, the clinical diagnosis was confirmed. We immediately forwarded the blanks to the Surgeon General and requested the necessary transportation, etc., and asked for further instructions. I had not received any reply when I left home. The woman will abide by the regulations and go to a leprosarium. She prefers to be taken away in some other way if possible. As a matter of information, I would like to be informed what is the laboratory finding or clinical finding to warrant the control of a leper.

Doctor SCHERESCHEWSKY. Doctor McCoy, will you answer that question, on what would be the basis of allowing parole to a leper—the clinical and laboratory basis?

Doctor MCCOY. The risk to the community depends largely on the geographical location. In Little Rock, or in the South generally, any case which is bacteriologically positive ought to be isolated. It is desirable, but not necessary, to isolate in an institution. Home isolation can be practiced with extremely small risk to the community.

The fact that the woman in question never was out of the United States does not have any particular bearing, since our Gulf coast is a recognized focus for the transmission of leprosy. In Florida and Louisiana practically all lepers are of local origin; in the North the reverse is true—that is, practically all are imported cases. One can unearth perhaps 50 cases of leprosy in New York at any time, but all these come from foreign countries or from the South. There is no appreciable risk of the transmission of the disease in a northern community.

This all has a bearing on the subject of uniform control. I doubt whether it would be wise to have a uniform system for the whole of the United States when the opportunities for communication of the disease differ in different parts of the country.

Furthermore, there are two clinical types of leprosy, one of which is practically free from risk of transmission. This is the anæsthetic or nerve type of the disease, and such cases are not a source of danger.

I want to conclude by adding my tribute to that of Doctor Trotter to the handling of leprosy in the Territory of Hawaii. I know of no community that has worked out a better program for the handling of leprosy than that little community in the middle of the Pacific Ocean.

Doctor GARRISON. Would it be feasible for the service to detail a man down there and advise whether it is better to let her stay home?

Doctor SCHERESCHEWSKY. It might be done, but I would have to take the matter up. Doctor McCoy might go down there. In the absence of the Surgeon General I can not make a promise, but we will give the matter consideration.

Doctor CRUMBINE. I will ask a question not appropriate to the matter under discussion, a question which has occurred to me a great many times, and I have never had an answer: Why is it that there are two places in the United States—Texas is one point; I think the other is in Charleston, S. C.—where absolutely no attention is paid to leprosy cases. They have perfect liberty. I do not know that it makes any difference what the type is. I assume there are both types. There is nothing done. There are 30 at Galveston that have liberty, and nothing has ever been done about it. I do not know how that is and why it is.

Doctor SCHERESCHEWSKY. It is certainly the province of the State health authorities to take such precautions as are necessary for the protection of the people in the State. If these lepers attempt to cross the interstate boundaries, then they become proper subjects for Federal action, and under proper information steps could be taken to limit the activity. The trouble is that many lepers are unknown, and pass in the channels of interstate commerce without anybody knowing anything about it. I believe the establishment of the national leprosarium and the appropriate enlargement to take care of the leprosy cases helps wonderfully. Improvements which are pending in the treatment of leprosy, and epidemiological studies, such as Doctor Lumsden suggested to us this morning, will pave the way for a control of the situation, but the Chair is in accord with the health officers from Kansas and Iowa, that there is no reason why they should be free and unsegregated in the points referred to, and it ought not to be.

Doctor CHESLEY. I was requested to start the discussion, because I handed the Surgeon General a telegram, which was that we picked up another leper in Minnesota, who was a citizen of the Soviet Republic, and who desires to return. Personally, I am perfectly willing that it be done. I do not see why in these cases where you have difficulty you can not put your patient into a plane and fly him to the point where he desires to go. No interstate law can prevent us getting there. I think it is a simple thing.

Doctor SCHERESCHEWSKY. That is a good suggestion.

The next subject is child hygiene, and I will ask Doctor Clark to open the discussion on that by giving us a short résumé.

CHILD HYGIENE.

Doctor CLARK. When I outlined for you the activities of the child-hygiene section last year, a good deal of our work was in the formative stage. Now, some of the results of the work we were then doing have become apparent.

With regard to the scope of the work, I think the proposed slogan for health officers, "Investigate, demonstrate, and educate," applies particularly to the work of the service in child hygiene, with emphasis on "investigate" and "educate."

Owing to the terms under which appropriations become available for child-health work, our activities are largely confined to investigation. However, it is impossible at times to conduct an investigation and not at the same time demonstrate, or demonstrate without educating. It is a very important form of education—demonstration.

Morbidity reporting by the school medical service, nurses, or teachers.—In line with the discussion regarding the establishment of a morbidity registration area, it may be of interest to note that we are attempting to determine the value of morbidity reporting by the school authorities, as compared with reporting in other manner. We use for this purpose the special school record card adopted by the service which provides for a record of absences from school on account of sickness to be kept by the teacher or by the school nurse. The value of this method of reporting will depend very largely on the thoroughness of the cooperation of the school authorities with respect to recording absences and regular and prompt reporting to the health officer.

Aside from the value of this form of cooperative work in keeping the health officer advised of the prevalence of particular types of morbidity in the community, it is also possible by this method to estimate in terms of dollars and cents the loss to a community from the inability of children to attend school because of preventable sickness. We have recently compiled material of this character relating to 6,130 children in 13 Missouri localities which shows that of a total of 666,449 possible school days' attendance 5.6 per cent of these days were lost through sickness. In other words, at a per capita cost for schooling of $25 for each child, something like $2,500 was spent in these Missouri districts to no purpose. It is true this money is spent whether these children attend school or not, but the point remains that a number of children do not derive the maximum benefit from the educational opportunity thus provided because of preventable sickness.

The educational value of the economic data obtained in this manner is very great. The health officer will be in possession of definite information regarding the number of children who have been kept away from school on account of sickness and the amount of money spent in a given locality for school purposes without definite result. He will thus be in position to use this information to advantage in securing community support of public health work.

As indicated by an analysis of the material collected in these Missouri counties, "Sickness among school children," which appeared in the weekly Public Health Reports of June 8, 1921, it is possible for a health officer to keep himself informed by this method not only of the percentages of the different types of sickness prevailing in a community at a given time but also with regard to the seasonal prevalence of special diseases.

Further study of the practical application of this manner of morbidity reporting is now being carried on in a more scientific manner as a part of the child-hygiene contribution to the health demonstration work which is now being made in Hagerstown, Md., in cooperation with the Maryland State board of health and other agencies. Using the service school record form, teachers are keeping a very close track of absences from all causes. The teacher's reports are carefully checked, followed up into the homes by special investigators, and are finally referred to the family physician for confirmation of the diagnosis. The whole study is under very careful supervision, and when completed we feel that we shall have some very definite information regarding morbidity in this particular community and the value of this manner of obtaining morbidity reports. Personally I believe that if we can secure the intelligent and hearty cooperation of educational authorities wonders can be accomplished by this method.

The effect of the correction of physical defects on growth and development.—At the time of the last conference mention was made of the study under way in the city of Baltimore of the effect of physical handicaps on the growth and development of children. Originally 200 underweight children, suffering from two or more physical defects, attending schools located in the more congested districts of Baltimore, were selected with a view to having these defects corrected and measuring the effect thereof by comparing the results of periodic weighings made before and after correction. However, owing to a number of causes, but 146 children were under observation for a sufficient length of time for accurate statistical purposes.

The correction of these defects was made possible through the hearty cooperation of seven Baltimore hospitals. These children were given no instruction in hygiene and given no special attention while under observation, other than securing the correction of the physical defects. The reliability of the results is strengthened by the fact that during the period these children were under observation many of the parents were without employment because of the very general economic depression.

It is interesting to know that of the 146 children on the school register in June, 1921, 3 children advanced 1½ years in school work. 134 were promoted to usual school grade, and 9 failed of promotion.

Of these latter, 6 children were already over age for their grade in school. Of these 146 children on whom correction was made, 43 per cent were over age for their grade and had repeated from one to four years prior to the time the correction was made.

I have not the time to give you the complete analysis of the results of this study.

With regard to the rate of growth of the adenoid and tonsil cases, the monthly percentage gain in weight before the operation of the boys from 7 to 10 years of age was 0.4 per cent and of the girls 0.2 per cent. Following the operation the percentage gain for the boys was 1.8 per cent and for the girls 2.5 per cent.

In the 11 to 14 year old group the monthly percentage increase in weight for the boys was 0.47 per cent before operation and 2.04 per cent after the operation, while for the girls the percentage increase was 0.84 per cent before the operation and 1.99 per cent after the operation, respectively.

The expected increase in weight of children comprising the first group is 0.72 per cent for the boys and 0.79 per cent for the girls, and in the second group 0.83 per cent and 0.97 per cent, respectively.

It is thus seen that, as measured by gain in weight, the correction of this type of physical defect, although unaccompanied by any other measure for improving the child's physical condition, is attended by a very substantial improvement as measured by increase in weight. While this study, by reason of the limited number of children involved, may be considered in the light of a preliminary inquiry, the results warrant an extension of studies of this character in order that more definite information may be had regarding the effect of the corrections of certain types of physical defects on the growth and development of children.

Special studies in nutrition.—In connection with the widespread interest now manifested in problems relating to the nutrition of children and the more or less general acceptance of underweight as a measure of malnutrition, I wish to impress upon you that many factors are conducive to underweight, and considered alone underweight is not a true measure of malnutrition—that this condition is only a symptom and not a distinct pathological entity. For example, it is possible to fatten an infant by feeding for a more or less prolonged period on condensed milk, and yet fail to promote proper skeletal growth or increase its vital stamina.

We have but recently compiled data relating to the estimation of the state of nutrition by methods other than the weight-height index. These studies were made by officers of the United States Public Health Service in the case of 9,973 school children and show some very interesting results. In addition to weighing and measuring these children they were classified on inspection as of "excellent," "good," "fair," or "poor" nutrition. All of these officers were skilled in estimating the general physical condition on inspection by reason of the experience and training gained in the inspection of thousands of immigrants at Ellis Island.

In analyzing and comparing the results of these observations it was found that—

1. The percentage of defective nutrition classified according to clinical evidence other than weight was highest at 8 years of age and decreased with age. This observation lends support to the contention of some authorities that child development may be divided into distinct periods approximately as follows: The plump, chubby period, extending from early infancy up to the sixth year: the lean, lanky period, covering the seventh to the eleventh year of age; and finally the period of puberty, during which individual children manifest distinct characteristics that will persist through life.

2. The children classified as malnourished from clinical evidence other than height and weight are shorter, lighter, and have a lower weight-height index.

3. Differences in height are much less significant in judging nutrition than differences in weight.

4. In comparing percentage distribution of two groups classified as of "good" or "poor" nutrition, according to clinical evidence other than height and weight, it was found that although the children in the latter group weighed less than those in the former group some of the children in the poor group weighed more than some of the children in the good group. It is reasonable to assume, therefore, that weight measurements alone are not sufficient to determine nutrition, but that these must be supplemented by medical examination.

There is very great danger that large numbers of inexperienced workers will be misguided by their enthusiasm in using the easily applied and arbitrary underweight index and lose sight of the fact that malnutrition is a medical problem.

Follow-up work in the schools.—Those of us who have been engaged in school hygiene work are conscious of the need of some more effective means whereby better results may be obtained from the medical inspection of school children. It is an extremely difficult matter to secure the cooperation of parents for the correction of hampering physical defects. Notification is notoriously ineffective. Follow-up work in the homes by the school nurse is expensive, time consuming, and too frequently barren of results. In seeking a remedy the Public Health Service has devised a health score form for use in classrooms designed to take advantage of group psychology to stimulate the child himself to demand the correction of notified defects.

The system is simple. Certain minimum health essentials are set forth, with proper headings under which the results of the physical examinations are recorded. In every instance where the child is free from physical defect corresponding to any one of these headings a red star is stamped in the appropriate column. The child is then informed that following the correction of certain existing physical defects or the attainment of the minimum standard a blue star will be placed in the appropriate column, and when all the spaces are filled with red or blue stars, singly or in combination, a gold star will be placed before his name.

Our experience in the use of this form during the past year has impressed our officers and the school authorities with its value. In some communities a very high percentage of correction of defects has been obtained through the importunities of the child brought about by this manner even in cases where no follow-up work whatever had been done by the school nurse.

New work.—With regard to the new work undertaken by the child-hygiene section during the year, mention has already been made of the cooperative work being carried on at Hagerstown, Md.

In connection with certain studies relating to the prevalence of tuberculosis which the service is making in cooperation with the State Board of Health of Utah and the Utah Public Health Association, particular attention is being given to the related child-hygiene problems. Large numbers of school children are being examined, and those who are found in poor physical condition are referred to special examiners for attention. Personally, I feel that the period of childhood offers the most promising point of attack in the control of tuberculosis. It is practically impossible to diagnose incipient tuberculosis in children by any method. In fact, a special committee of the National Tuberculosis Association is on record as stating that even by the use of the X ray, unless the findings show involvement of the lung fields rather than the lung roots, the diagnosis of incipient tuberculosis can not be made in the child. For these reasons, a child presenting the combination of symptoms classified under malnutrition should be regarded as potentially tuberculous and the necessary means should be taken to improve his general condition. Child hygiene, by safeguarding the health of expectant mothers and assuring the unborn child a sound birthright; employing special means for reducing infant mortality and assuring better care, attention, and management of infants and children of preschool age; concerning itself with the improvement of school health supervision; and securing better provision for safeguarding the health of children engaged in industrial occupations is one of the most potent factors in the control of tuberculosis.

On request of the State and local health officers, the Public Health Service has been making special investigations in school hygiene in Bedford, Ind., and in Memphis, Tenn. The work at the latter place is too recent for me to give you the results of these studies at the present time.

In Bedford, Ind., however, our studies have developed some interesting information regarding the relationship of posture to malnutrition and also regarding the association of bad posture with physical defects. These investigations will be made the subject of special reports. In addition, the work of the service officer has been instrumental in bringing about the adoption of a system of health instruction in the public schools of the city which in itself, from the public-health standpoint, is ample compensation for the time and energy spent in these investigations.

The service has also been making some very extensive investigations of special child-hygiene problems in cooperation with the State board of health of Florida and the State federation of women's clubs. In order to secure material for special studies, the service has been obliged to do some extensive routine supervision work in the schools of two counties of the State. We have been particularly interested in collecting material for use in an attempt to prepare more accurate standards of physical development than those at present generally employed, and also for the purpose of studying the effect of certain physical defects and endemic diseases on school progress and the growth and development of children. The work is still under way and no definite information bearing on these points can be given at the present time. However, some very interesting side issues have developed as a result of our special studies which manifest the aroused interest of the local community in child health work. In one of the counties where we have been working better provision is being made for school health supervision, a number of nutrition clinics have been organized and operated, a child health center has been established to be operated by the committee of the local medical association on the withdrawal of Federal forces, and finally an arrangement has been perfected whereby the local dentists will give free dental attention to every necessitous child referred to them by the school authorities.

The activities of the service's mouth-hygiene unit have been largely confined to the State of Florida during the past year. In the counties where special studies of the effect of physical defects on the growth and development of children have been made the mouth-hygiene unit has examined, charted, and graded the mouths of the entire school population for use in determining the effect, if any, of bad mouth conditions on the child's physical growth.

As a result of the special investigations of the mouth hygiene unit, officers of the service are coming to a realization of the possibility that dental caries alone is not so much a factor to be considered in respect of the health and the school progress of the school child as is mouth sepsis evidenced by gingival infection and other inflammatory conditions of the oral tissues. According to these studies, a very interesting and strongly probable relationship between mouth sepsis and school progress seems to exist. In a very large number of instances, in fact apparently too large to be considered a mere coincidence, it has been found that for children with low mouth sepsis ratings, according to a method of grading devised by the unit, there is a corresponding low school rating, and vice versa.

In conclusion, I wish to say that I had hoped to make a few remarks regarding the organization of child health work on a Statewide basis, but I have already used up too much of the allotted time. In devising such a plan the health officer or the director of the division of child hygiene should make a comprehensive survey of his territory for the purpose of determining the most pressing child hygiene problems of the different communities, and to take stock of local resources, including the amount of cooperation that may be expected from auxiliary agencies. Our experience has been that, while a completed plan of child hygiene work is desirable, but few communities are in position financially or otherwise to put an all-embracing plan in operation. However, every community has one or more special problems which require special attention. The solution of such problem or problems should be the entering wedge, and as local resources increase the work may be gradually expanded.

Finally, I wish to emphasize that because of the interrelationship of all health problems any State-wide or local plan of child health supervision should provide for a very definite correlation of the child hygiene activities with the other activities of the State and local health department. Such correlation is advisable not only from the standpoint of economical expenditure of funds but it also promises the best results.

Doctor SCHERESCHEWSKY. The next subject on the program is the provision of the act of November 23, 1921, entitled "Promotion of the welfare and hygiene of maternity and infancy, and for other purposes," with special reference to detailed plans for carrying out the provisions of the act as specified in Section B in section 8.

We have with us to-day Miss Grace Abbott, the Chief of the Children's Bureau, and it is going to be our pleasure to have Miss Abbott address us on this most important topic.

I believe the recognition of the necessity for the protection of infancy in childhood by the Federal Government is of the most importance and a milestone in the progress of public health.

It gives me great pleasure to have Miss Abbott address you.

Doctor CUMMING. If Miss Abbott will allow me to make a short statement, I will appreciate it.

A friend of mine is in town, from Chicago, to help the Government in a voluntary way, a man who had done a great deal for the Government in the last year. He was suddenly taken sick about 12 o'clock, and General Dawes called me up about it. We have taken him to the Emergency Hospital, and they are about to operate on him, and while he was put under the anæsthetic I ran over here to apologize for not being with you this afternoon, and I am sure you understand it.

I hope we shall have the pleasure of meeting again next year and have a good meeting. I also hope that we shall have a very successful year in the following 12 months.

Before Miss Abbott has anything to say I want to say that we are working together in the utmost harmony, trying to carry out the intent with respect to maternity, and we hope it will result in a great deal of good.

PROMOTION OF THE WELFARE AND HYGIENE OF MATERNITY AND INFANCY.

Miss ABBOTT. I have not very much to say to you this afternoon, because I think we covered practically all the points that any of you wanted any information about on Monday afternoon.

It did occur to me, on thinking it over, that there was one thing I omitted to say. I did not report the progress with reference to the acceptance by the States of the Sheppard-Towner Act. Forty-two States have now accepted it, 11 by legislative acts, and the rest by the action of the governors, pending the next session of the legislatures. The plans of 33 States have been approved in final form, and we are hoping that the other plans will come in soon.

Doctor Cumming and Doctor Tigert, when he has been in town, have been very generous in giving the necessary time to the work of the board, so that we have been able to act on the plans promptly.

I am not able to say as yet that the comptroller is ready to pay over the first allotments. I hope, however, that all questions will be settled, so that this will soon be possible.

A great many of you have been discussing with us at the bureau your individual plans, and Doctor Rude and I appreciate very much having this opportunity of meeting and talking with you. We all have many problems, which I am sure will be solved in the years to come, and, unless there are some questions some of you would like to ask, I do not intend to say anything more now. I know you are already tired, and there will be more speeches this afternoon from persons whom you have not yet had an opportunity of hearing, and I am very glad to give way to them.

Doctor **Schereschewsky**. This subject is now open to discussion. If there is no discussion on this topic, we will proceed to the next topic, which is "Nutritional disease."

I will ask Doctor Goldberger to make some statements.

NUTRITIONAL DISEASE.

Doctor **Goldberger**. Mr. Chairman and members of the conference, I think some three or four years have passed without my attending these conferences and without making a report of progress. The main reason for this is that the progress of our investigations of pellagra was such that we did not feel prepared to report on them.

The results of the work of the past four years have confirmed the indications of our earlier results, which, as you know, pointed to the protein factor as the one concerned equally in the production and in the prevention of the disease. The indications are well-nigh conclusive that there is some fault bound up with the protein, in all probability with respect to the make-up of the amino-acid mixture, that is the essential factor concerned in the cause of the disease pellagra.

It hardly seems necessary to go into discussion of our recent results at this time, for they have already been dealt with in a report published in the Public Health Reports a few weeks ago (March 3, 1922). I may say, however, that additional confirmatory observations have been made of those there reported pointing to the protein factor as the essential one. Notwithstanding all this, we feel that there is still much to be done before it can be said that all possible dietary factors other than protein have been absolutely excluded from consideration.

Aside from their immediate bearing on the program of pellagra, the results of our studies have a broader significance. They suggest that a specific condition—a specific human disease—may result, so far as we can at present judge, from a defect in the protein factor alone.

Doctor **Schereschewsky**. Is there any discussion of Doctor Goldberger's talk? If not, the recent outbreaks of virulent smallpox in certain sections of our country and the fact that vaccination is not being practiced with the assiduity with which it should be practiced in a number of sections of the country render some discussion of certain features of the vaccination against smallpox pertinent at this time, and I will ask Doctor Leake to open the discussion in this matter.

VACCINATION AGAINST SMALLPOX.

Doctor **Leake**. Gentlemen, the hour is late; there are a few points that I think may not be generally appreciated, and I want to touch upon those only.

The chairman referred to the virulent outbreak in the two Kansas Cities; the infection has spread from there to other places, notably Denver.

The form of the disease which is prevalent there is the old text-book form, our milder American smallpox being a less virulent form rather than a separate disease. The smallpox in Kansas City was a type which had a mortality of from 30 to 40 per cent. There is one point in that outbreak which seems to be true of other severe outbreaks, and which deserves to be mentioned—the contagiousness of the disease under these conditions. Apparently it is more contagious, as well as more fatal, so that more severe measures have to be taken in isolation; further, in regard to vaccination, one can not be sure of an old vaccination protecting to the same degree as it does against our milder form. In Kansas City we found a few cases in this epidemic that were vaccinated as recently as three years ago, with perfectly good scars. These cases tend to be somewhat milder, of course. None of those who were vaccinated two to two and a half years ago had fatal cases, but it would seem that to promise immunity one should ask for revaccination in the presence of such a contagious outbreak unless one has been vaccinated within two years.

Furthermore, vaccination during the early part of the incubation period did not prevent the disease. The vaccination should be performed before exposure. We can not hope to do all the good we can unless we get our communities vaccinated earlier.

Everyone knows that we would like uniform vaccination at school age. It is appreciated that this can not be had in certain communities. The population will not stand for it. In some communities, in the most populous ones, school vaccination is in vogue; we hope that it always will be, and that there will be no stepping back from as much protection as we have.

In Sweden recently the vaccination laws have been amended so as to adopt the American plan of vaccination at school age, instead of the usual European method of vaccinating in infancy. If only one of the two were to be selected, the American method is better. Certainly the English idea of one vaccination giving perfect protection, provided there are four good-sized scars, covering a square inch, can not be held entirely sound—it probably is a good method, but any infantile vaccination will gradually lose its protective power in a considerable proportion of individuals. If we had one time to choose it would be the school age, as this would probably give the more lasting immunity. Two advantages of vaccination in infancy are, there is usually no fever, and the scar tends to fade.

One minor point in regard to the apparent failure of vaccination in such an epidemic as we had in Kansas City; a few cases were seen where, according to the description at the hospital, the patient had a good vaccination and still came down with smallpox, the facts being as follows:

Vaccine virus was inserted on the arm, but no exact record had been kept of the date of insertion and the date of the appearance of the vaccinal reaction; the sequence of events was learned only on questioning the patient and using a calendar to help him fix dates. The vaccine virus was not potent and lay dormant in the skin; instead of coming up to a maximum "take" in 9 to 11 days, it showed no signs of "taking." The patient was exposed to smallpox and the smallpox fever came on in 12 days after exposure, the virulence of the infection stirred up the attempted vaccination so that this became the first site of the smallpox eruption and came out a day or two before the general eruption. It was not the failure of vaccination to protect, but failure to get a vaccination.

In regard to the so-called "alastrim": In this country there is no trouble, except in individual cases, with the diagnosis of mild smallpox. The epidemic itself is easily diagnosed. There is no reason for regarding the alastrim of the West Indies as anything different from our mild smallpox. It is the same disease. . The fact that there are few or no deaths has nothing to do with the way it should be handled. The other features of alastrim are present in our epidemics of smallpox.

In regard to the so-called reactions of immunity, the reactions which take place on the arm when a person has already been protected by previous vaccination, there seems to have been some question as to how these appear and what the absence or presence of the reaction means. If a person is vaccinated with a potent vaccine, there is always some reaction. In cases with no previous immunity there is the regular primary vaccinal efflorescence, with the maximum at about 9 days, practically nothing during the first 2 or 3 days, and the widest extent of redness at the 9 or 11 day period. If a person has a slight amount of immunity, the reaction will begin a day or two sooner and come up to its maximum around the seventh day, the total area not being so great as in a primary "take," although on the seventh day you may notice a higher reaction than in the case of the corresponding primary vaccination at that day. The reaction of immunity, occurring in those who are moderately to highly immune, is a briefer affair, the reaction coming up ordinarily with a person who has not been vaccinated in three or four years, so that it reaches its maximum about 48 hours after inoculation. A reaction in one of these three forms will take place with practically every person who is vaccinated with vaccine, and this reaction can have a maximum at any point within 10 or 11 days; commonly anything in the first 3 days is called an immune reaction; anything from

3 to 8 days an accelerated reaction, and from then on a regular vaccinia.

The early reactions generally indicating immunity can take place with dead virus, but active virus is necessary to get the proper interpretation of the reaction.

Doctor SCHERESCHEWSKY. We will now hear from you, Doctor Beatty.

Doctor BEATTY. I am not proud of the fact, but Utah can claim the distinction of having had the highest smallpox rate in the United States every year for the past 20 years. There is a reason. I might say 22 years to be more exact, because it was at that time that the State legislature passed a law expressly prohibiting health authorities or school authorities from excluding unvaccinated pupils from school or requiring the vaccination of any individual in the community.

I think the facts are rather interesting from an epidemiological standpoint, worthy perhaps of careful study, because they can not be duplicated elsewhere.

I need not go into the causes leading to the enactment of the freak law other than to say that it was a result of fanatical antivaccination activities in high places. The result of the law and adverse public sentiment responsible for it has been a largely unprotected population. I can not recall a year in which smallpox has not been prevalent, assuming epidemic proportions in many years. In 1920 there were 5,000 cases, and 1921 more than 3,700; the population of the State is 450,000.

The presence of the malignant type of smallpox in Kansas City, Denver, and other western cities last winter, however, has had a tremendous influence in changing the sentiment and stimulating vaccination, and there is reason to believe that the repeal of the antivaccination law may be accomplished at the next session of the legislature.

Doctor TURNER. I just want to take a minute to tell you a little of the situation in the State of Washington. I do not want to fight with Doctor Beatty in saying that we have more smallpox in the State of Washington than in any other State in the United States, but I believe we come pretty near having the most, or we did have some years ago.

Last year, in July, the State board of health passed a regulation in order to control smallpox to the best of our ability, so we proceeded to put this rule into effect, and immediately ran into all sorts of difficulties and the usual fights to get the procedure over.

It went to the court in Thurston County. We received a decision, and they appealed to the supreme court. I do not care to take up the time to tell you the whole situation. I merely want to read the decision we obtained of the supreme court, and it is so good that I really stopped thinking about passing any laws on public health in the State of Washington. It makes it a regulation so flexible that we are pretty well off, I think. This is a part of this decision:

> The statute declared the act of the board of health to be final and conclusive, and not to be reviewed by the courts or denied, because the authority may be abused, or the law maladministered, and that the finding of facts by properly constituted health officers is final and binding upon the public school and upon the courts.

There seems to be nothing further which needs to be said.

Doctor SCHERESCHEWSKY. We will suspend the program for a few minutes until we receive the report of the resolutions committee.

REPORT OF RESOLUTIONS COMMITTEE.

Doctor DALTON. Mr. Chairman, the following resolutions have been presented to the resolutions committee, which have been passed upon by them.

The first was read, as follows:

> Whereas a considerable number of cases of leprosy are known to State health authorities and nearly all of these cases are living at their homes or are being cared for elsewhere under conditions unfavorable to treatment of the disease even if favorable to protection of the public; and
>
> Whereas the Congress of the United States has enabled the Public Health Service to take charge of and enlarge the institution at Carville, La., so that a limited number of cases have been admitted from several States and now are being given the best possible medical treatment under very happy and comfortable conditions of living and of environment which give great promise of arrest if not complete cure of the disease; and
>
> Whereas many unfortunate sufferers who have learned of this institution and its advantages and being desirous of obtaining treatment therein find that the accomodations are so limited that no hope seems to remain of possible relief or cure in their cases: Therefore be it
>
> *Resolved*, That the State and Territorial health authorities here assembled in official conference with the Surgeon General of the United States Public Health Service respectfully petition the Congress of the United States to appropriate a sum of money sufficient in the opinion of the Surgeon General to enlarge the Carville institution and provide ample facilities for care and treatment of all cases of leprosy referred by the State health authorities.

The resolution was adopted.

Doctor Dalton thereupon read a resolution which was adopted in the following form:

> Whereas the conference of State and Provincial Health Authorities of North America have gone on record that changes in the sanitary railroad code are not advisable annually, but that the same be made not more frequently than at five-year periods, or when necessary, and has instructed the committee to act accordingly: Therefore be it
>
> *Resolved*, That the Surgeon General of the United States Public Health Service appoint a committee on railway sanitation, and that this committee

shall report every five years coincident with the report of a similar committee of the conference of State and Provincial Health Authorities of North America.

The next resolution was read, as follows:

Resolved, That the Surgeon General of the United States Public Health Service be requested to petition Congress for a sum, to be appropriated, for the fiscal year beginning July 1, 1922, sufficient for the organization and maintenance of a registration area for morbidity; and that the members of this conference pledge their utmost effort, in cooperation with the Surgeon General, to secure such appropriation from the Congress of the United States now sitting.

Doctor **Schereschewsky**. The resolution is now open for discussion. The Public Health Service has earnestly petitioned Congress at least five or six successive years for an appropriation to carry out the purposes in this resolution, without having the money appropriated; and while it is eminently desirable that a start be made as soon as practicable in the establishment of a registration area for morbidity, the point that rises in the mind of the Chair is if this is the most effective way. If, for instance, some petition from the State health officers could reach Congress which would provide for that, I think the results would be very much more effective.

Doctor **Dalton**. I would like to hear from Doctor Fulton.

Doctor **Fulton**. A resolution like that would do no more than empower the Surgeon General and express our sympathy, but by adding the clause the Surgeon General might feel free to call upon us to make that resolution more effective. I tried to write a resolution which would have that effect. We will render what service we can.

I will agree to the omission of any phraseology that other members of the conference find objectionable or useless.

Doctor **Schereschewsky**. The only thing I had in mind is that there is only one way in which the Surgeon General can make a request on Congress for an appropriation, which is to submit an estimate to the head of the Treasury Department and have a special request for an appropriation proceed from him to Congress, and he can not approach Congress in any other way than the old official channels.

Doctor **Fulton**. This conference has no approach to Congress at all. It is appropriate for us to send a memorial to Congress on our own initiative.

Doctor **Schereschewsky**. I merely wanted to make the position clear. The fact that this conference of State health officers with the Public Health Service have come on record to show that they are in earnest in desiring the morbidity registration area would have weight with Congress.

Doctor DILLON. I recommend that the Surgeon General include in his next estimated budget a sum sufficient to defray the expenses of a division of morbidity registration, and that this conference of State health officers pledge their support in an effort to have that enacted into an appropriation next year.

Doctor SCHERESCHEWSKY. Of course there will be an estimate included as a matter of course in our next annual appropriation. In order to make some kind of a substitute it is desirable to begin as soon as practicable, because the regular appropriation next year, for which estimates will be made, would not become available until July 1, 1923, whereas if we are to do any useful work along these lines actual work ought to begin with the calendar year January 1, 1923, so that would preclude any work supported by this appropriation being done until January 1, 1924. It seems to me, Doctor Dillon, that possibly this resolution which we have here from the resolutions committee places the service in a better position in regard to getting the money for this work.

The resolution was adopted.

Doctor Dalton thereupon read the following resolution:

Resolved, That the State and Territorial health authorities present their thanks to the Surgeon General of the United States Public Health Service and his assistants for the profitable and instructive conference which has been carried out this year.

The resolution was adopted.

The last resolution read as follows:

Whereas the protection of property against loss through fire has led to the installation of connections between safe public water supplies and those which are polluted with sewage; and

Whereas epidemics of typhoid fever have been due to pollution of public water supplies when these supplies became insufficient for control of fires and the emergency fire connections were used to secure more water; and

Whereas in nearly all places the emergency connections are made for the reason that it is convenient rather than the only means by which the needed fire protection could be secured; and

Whereas in case no safe supplemental water supply is available it is possible to eliminate the danger of pollution of the public water supply system: Therefore be it

Resolved, That the State and Territorial health authorities request the Surgeon General of the United States Public Health Service to communicate with the National Board of Fire Insurance Underwriters for the purpose of enlisting that board's cooperation with health authorities in protection of human life through the adoption of a policy forbidding physical connections between polluted sources of water supply and public supplies, and that any means of protection against pollution, whether in existing or proposed supplies, shall be approved by the State health authorities.

Doctor SCHERESCHEWSKY. You have all heard the resolution. Is there any discussion?

A **Member**. The question arises in my mind as to how you are going to help yourself. When a town has a limited amount of money, and has bonded itself to the limit, and has not a good water supply, they must have fire protection.

Doctor **Schereschewsky**. This resolution does no more than minimize these conditions; and if this matter is placed under the jurisdiction of the board of health it would have records which do not exist now within the knowledge of the board of health, by-passes and all connections, and some supervision can be maintained over them. I realize the practical difficulty in the rigid enforcement of this.

Doctor **Chesley**. In Minnesota we have had several epidemics due to physical connections for fire purposes. The emergency occurred, and they turned it into the water supply. The damage was done before anybody knew about it. We have found in places where they are putting in new supplies, and needed a supplemental supply for emergency purposes, the influence of the insurance companies was against making any provision for the protection of the public in such an emergency. It is possible through such mediums, which would vary under different conditions, to protect the supply, even if you have to take it in emergencies. That is what we are trying to do. We should not arouse the opposition of the fire underwriters and other commercial organizations when we attempt to safeguard the water supply against possibilities of pollutions. That is the whole intent of the resolution—to gain their cooperation and limit the active opposition which very often prevents getting something like that done until after an epidemic occurs.

The resolution was adopted.

Dr. **Schereschewsky**. Now the question is as to adopting the report of the resolutions committee as a whole.

A **Member**. I move its adoption as a whole.

Doctor **Schereschewsky** It is moved and seconded that the report of the resolutions committee be adopted as a whole. All in favor will signify the same in the usual manner.

(Report of resolutions committee adopted as a whole.)

We will resume the program. The next topic is the question of industrial hygiene. In view of the growing importance of this phase of public health, I will ask Doctor Thompson to discuss this.

(Doctor Thompson thereupon read the following paper:)

INDUSTRIAL HYGIENE.

In opening the discussion on industrial hygiene I would like to remind you of several facts. In the past several years students of epidemiology and State and local health authorities have begun to take notice of the importance of those diseases represented by heart disease and Bright's disease which are becoming each year a more and more important factor in the general death rate. Our interest is naturally not so much with the disease itself as with the underlying causes which contribute to the disease. It is true, of course, that a part of the apparent increase in the mortality rates from these diseases is due to the decreased mortality in communicable diseases, such as tuberculosis and typhoid fever, but nevertheless any disease which represents to us the beginning of the impairment of the physical machine can not fail to attract and hold our undivided interest.

The field of preventive medicine that State health officers have been interested in in the past has been so broad, with perhaps the funds for the work so small, that industrial hygiene and sanitation has received but little consideration. This is evidenced, I think, by the fact that the majority of States have either very incomplete industrial laws or none at all, and the divisions of industrial hygiene are to be found mainly in State departments of labor rather than State health departments. In my own mind it is quite clear that with the realization of the importance and the necessity for studying the causes of organic diseases such as I have referred to, the relative importance of industrial hygiene and sanitation will stand out with increasing significance.

Every physician is acquainted with the symptoms and effects of lead poisoning, and this class of poisoning has probably been more completely studied than any of the toxic metals. The result is that it has been definitely proven that permanent degenerative changes take place in excretory, circulatory, gastrointestinal, and nervous systems. Thompson, in his work on occupational diseases, states that more than 150 different trades subject the workmen to plumbism. The extremely wide variety of these trades, including as they do mining and smelting, painting, pottery, glass industries, shipbuilding, paper making, and others, makes it evident that in every community we will find the hazard and that the number of people exposed to this single poison is extremely large. While the actual number of cases of lead poisoning that are found may not be startling, on the other hand there are thousands of workers who have received a permanent physical handicap they must carry through life, no matter what their future occupation.

I have taken lead as only one example of a group of hazards, and in a great majority of work processes health hazards of the same sort exist. It is my own opinion that the State health officials in the near future will be compelled to recognize the importance of the industrial life of their communities if they expect to make any great impression on their present death rates.

The program of the Public Health Service in industrial hygiene and sanitation may be taken up under four main divisions:

First. Scientific investigation as to the cause, effect, and prevention of the more important health hazards, especially the principles of ventilation, illumination, and industrial sanitation, in order to make data available to State and local authorities for use in the formation and standardization of their industrial codes.

Second. A study of industrial sickness or morbidity records to determine the nature of such illnesses and the relative importance of various industrial health hazards in their causation.

Third. The maintenance of a consulting service for the benefit of industry, the individual employer, and State and local health authorities where questions regarding industrial hygiene and sanitation can be answered from the available literature on the subject.

Fourth. The introduction of the principles of industrial hygiene and sanitation into Federal business to eliminate the known health hazards that exist in the many divisions of work now being carried on by the Government.

Doctor SCHERESCHEWSKY. The subject of industrial hygiene is now open for discussion. I realize all the State health officers have been actively employed in the problems of the protection ot the public from the diseases which kill so many, but inasmuch as I know it is the aim of all of us to round out our health activities to the fullest possible extent, it seems to me in the future at least more thought must be given to the active measures in regard to industrial hygiene, for by so doing we protect the health of a group of individuals which is somewhere in the neighborhood of twenty-five or thirty millions.

Is there any discussion of Doctor Thompson's paper?

As most of you are aware, we recently had here a conference on the education of sanitarians, and as a result of that a committee was appointed. I will ask Doctor McLaughlin to make some statements as to the status of the work.

EDUCATION OF SANITARIANS.

Doctor McLaughlin. I know you are all tired, and I will take but two minutes.

The question of education of sanitarians is of deep interest to us, because the carrying out of the education of sanitary officers depends upon the cooperation of the health officers on the one side and the educators on the other. I am speaking because of misunderstandings that have occurred.

In the first place, if we had invited this conference and had present the health officers like you and like me in sufficient numbers, the shrinking violets of deans of medical schools and university presidents would have sat back, and we would have gotten no opinion from them—for that reason we failed to feature the practical health officer like you and me. We had a marvelous conference, so far as the attendance of these shrinking violets of educators is concerned, and we got them here and explained the problem to them. Another criticism that was made was that the newer phases of public health, such as child hygiene, were discussed and presented in half-hour papers, which is absurd; but we had no thought in mind of giving them a complete education.

We made an outstanding picture of each particular phase of child hygiene so that they would know, and know in some instances for the first time, that these phases were a necessary part of the education of the health officers and of the education of the raw material from which health officers are produced.

Another criticism that was made was this: That the conference contemplated the education of the ideal health officer who must know everything about everything. The only answer to that is, while a large part of the conference was devoted to the health officer of the future, the one we would like to have, and it was thought wise to look into the future to that extent, we all realized that the big problem to-day is the training of the sanitarians now employed, and the education of the raw material that we will be compelled to utilize for the next generation, regardless of any special schools of public health that may be established.

The result has been mailed to you, and a committee was appointed to follow it up to bring about the improvements in the education of the health officers. This committee in its work put a large part of its effort on the education of the health officers now employed, and the type of material we have to employ, and out of that the practical side will be taken care of, as well as the ideal side—what Doctor Vincent called, in his inimitable way, the education of the superman.

I make this explanation so you will understand we had no such thought in mind. Doctor Garrison and Doctor Chesley and myself, who received our education in the university of hard knocks, would be the last to belittle that type of education which succeeded so well; but we thought it would be well to look to the future, so that the kind of men we would like to see with the kind of training it took 20 years to get, might be produced in a much shorter time.

Doctor Schereschewsky. Is there any discussion of Doctor McLaughlin's progress report?

We have on the program the immigration problem. It is a big problem, and has had a powerful effect on the complexion of this country. I will ask Doctor Kerr to open the discussion on the matter.

Doctor Kerr. Gentlemen, I feel that I can bring in no concrete suggestion or recommendation to you regarding the problem of immigration at this time. I assume the secretary of the conference called on me by reason of my recent association with these problems at Ellis Island. I was in charge of the medical work there for three years. Anyone who has been there and has been associated with problems of the groups of people who have come to this country must be impressed with the enormous importance of immigration. The migration problem is probably one of the greatest factors, and has been through thousands of years, in changing the character and destiny of nations.

Perhaps the best example of the effect of immigration may be seen in the valley of the Danube and the Balkans, through which western migrations have traveled for 1,500 years. There is no section of the world that I know of that shows as well the ill effects of these world movements.

Our immigration problem relates, first, to the future of the race; and, secondly, to the immediate effect of arriving aliens on the public health.

The States on the Atlantic seaboard are confronted with these problems to a greater extent than the Central States. By reason of the examination of large groups of men who went into the Army we were impressed with the influence of certain groups upon the physical status of our population more than otherwise would have been the case. Statistics on the examination for the draft show that the stature of the recruit on the Atlantic seaboard was less than in the Central States, and this characteristic is attributable in a large measure to the accretion to our population. In those States where the immigrants have settled and the alien population is large health officers should give careful attention to their presence in the general population and endeavor to carry on work especially for them.

Last year at the conference I referred to the attention that was paid to the education of children while they remained at Ellis Island. That, of course, is the very beginning of a large social obligation on the part of this country. It has helped that phase of the immigrant's life.

I would like to impress upon the members of the conference that there is no movement going on in this country that so vitally affects the future of the country as the problem of immigration. We are now, with the very reduced immigration, getting almost a half million people into this country a year. Formerly they came over in millions—over a million a year. It is utterly impossible for the American population, as large as it is, and as open-armed as it has been, to assimilate such vast numbers, and those of us who have been in close touch with it feel what a great problem it is.

From a race standpoint we do not know what it means. We know perfectly well that if we were going to breed a better line of horses we would not go down to Central America and bring mongrel ponies here. We would go to Europe and get the best stock we could find.

There are many, many sources of immigration in Europe—people who would be glad to come—those that we can assimilate—and it is that class of the population that should be encouraged and the other class should be discouraged. The sick and disabled, those suffering from excludable diseases, should be kept out of the country. We have not been so fortunate in this respect as we should be. There have been cases landed in this country who are excludable under the law, and by reason of the conditions of war they were not returned. They left with us seeds here and there of defective stock. I do not know that there is anything this conference can do with respect to these matters. It is a Federal problem; but if the conference and those interested felt that the people of the country realized the problem that confronts them and could support their hands, I dare say our laws would be more stringent, and we would be assured of their better enforcement.

Doctor SCHERESCHEWSKY. Is there any discussion? If not, we will take up the last subject on the program, "Rabies eradication by vaccination of dogs."

RABIES ERADICATION BY VACCINATION OF DOGS.

Doctor STIMSON. Mr. Chairman and members of the conference, a little over a year ago three Japanese investigators reported that they had a method for immunizing dogs against rabies. They supported this by laboratory experiments and tried it out on a large scale. Some 15,000 dogs were immunized. These were pet animals, and up to the length of the period of observation they reported that not a case of rabies had appeared among these immunized animals.

At least one manufacturer of biologic products in the country took up this matter experimentally to begin with, and the experiments indicate that the findings of the Japanese can be supported. They have already put on the market a preparation which can be used and is being used by owners of valuable pet animals.

Now, the question I would like to put to the conference is, Is it possible that this method may be employed for the widespread immunization of the dog population and may it prove a valuable weapon in the suppression of rabies? In some areas the losses from rabies are very considerable. The principal loss, of course, is live stock. The second loss, I suspect, in actual money value is in the amount which must be expended for the treatment of exposed persons. The third loss is the actual loss of life computed in dollars and cents. This is a relatively small item, because the Pasteur treatment is usually successful. I suppose that a good many States are expending a good deal of money in measures intended to in some way combat rabies, but these methods, I think, are usually ineffectual, except that they do limit the number of human deaths.

It occurs to me that if the contention of the Japanese investigators is correct, that by a single injection of this preparation a dog can be almost permanently immunized, there may be the means of fighting the disease which will prove economical and practical.

I would like to leave the question with the members of the conference to see whether in their own States, granted the method is practicable from a purely scientific standpoint, it would save them money and add to their prestige in getting rid of a disease, or be a practical thing to put into operation. At the present time, of course, all States, or I suppose many of them at least, have regulations regarding the licensing of dogs. I suppose they are very commonly evaded. In country districts you will find five dogs on a farm and none licensed at all.

Suppose it were possible to drive up to a farmhouse, to go to the farmer and say, "Have you ever lost any stock from hydrophobia or rabies?" I think in many cases you would get a positive reply. In some places you could hardly go to any farmhouse without getting a positive reply. If you could say to this man, "We have in the wagon some stuff that will immunize your dogs; they will not have rabies any more, and at the same time we are willing to indicate that these dogs are protected by putting a tag on them," I think such a proposition might meet with success. Heretofore I have heard it said that if you went into a country district and tried to round up dogs, and tried to make people pay their license, and put a tag on them, you had to send an army along with the inspector to protect him. Otherwise he would be shot within a few miles. That statement was made to me by an inspector of a State live-stock board. I think that is practical, but I would like to leave it to the conference.

The work of the Japanese seems to be good. We have not done any experimental work with it as yet, and I do not think it is worth while doing, unless the State health officers report to us it would be a practical method, provided it was confirmed that you could immunize dogs in this manner.

Doctor WELCH. How many doses do you have to give to a dog?

Doctor STIMSON. One.

Doctor SCHERESCHEWSKY. Is there any discussion?

Doctor BEATTY. Early in 1917 rabies entered Utah, never having been known to have existed there before. It had been introduced in southern California some years earlier, spreading through the State into the other Pacific States and by way of Nevada into Utah. Much damage had been experienced and the prevalence of the disease was very extensive.

A conference was called by the Surgeon General in Salt Lake City, attended by State health officials of Pacific and intermountain States to consider ways and means of prevention. It was recognized that a difficult and unusual problem was presented by the fact that coyotes and other predatory animals were numerous throughout the region and that measures looking to their destruction were essential.

Following the conference the United States Biological Survey joined forces with the State and an effective campaign against predatory animals has since been waged with considerable success. The attempt to enforce the muzzling of dogs has proved ineffective, partly because of the lack of public sentiment notwithstanding the very large loss of live stock, and the fact that more than 150 people in Utah have been bitten by rabid animals. There have been three fatalities, only one of whom had received antirabic treatment, and we are unable to vouch for the administration in this case, as it was not given by the board of health.

With the exception of a very few cases the treatment was administered by the board, for the greater part using material furnished by the United States Public Health Service. Doctor McCoy may be interested to know that in one of the exceptional cases, where the material was sent to an outside doctor, the entire first half of the treatment was given at one dose without apparent ill effect. In another case the glycerine in the bottles instead of the sections of cord was injected.

The prophylactic inoculation of dogs appeals to me; but what are we going to do about the coyotes which continue to be our worst problem?

Doctor STILES. The suggestion is particularly opportune at this time. The live-stock industries of the country are thoroughly awakened to the importance of the dog in the transmission of diseases.

Doctor WELCH. The Georgia State Board of Health some two years ago made a survey of the country and issued a statement to the effect that rabies was more prevalent in Virginia, North Carolina, South Carolina, Tennessee, Georgia, Florida, Alabama, and Mississippi than in all the balance of the United States.

It is a very serious problem in the State of Alabama and the South, and if it is possible to vaccinate the dogs against it we can solve the problem.

I am very sorry that I have strapped up my charts, because I have a very graphic outline on the work which has been done in Alabama. I will say to Doctor Beatty that it does not make any difference how well you treat them, a few of them are going to die. We lose on an average 1 in 900. We treated as many as 1,800 parties bitten without a death, and then lost 2 right together. Our average is 1 in 900 people treated. We treated anywhere from three to four hundred a year, and we have lost during that time since the establishment of the Pasteur Institute five or six—I have forgotten the exact number—and during that time there have been 22 people in Alabama who died who were not treated. The theory is if the tooth of the dog penetrates a nerve sheath the man is going to die. All the cases that we have lost have been bitten about the face or hands. In every case that comes to us bitten in the face we push the dose to the verge of tolerance, but even then we lose the majority of them. We are more fortunate when they are bitten about the hands, but wherever they are bitten about the fingers or on an exposed surface we push the dose to the verge of tolerance.

If it is possible to immunize dogs, it seems to me the problem has been solved. It should not be difficult to obtain laws compelling the immunization of the dog population. I would like to see the United States Public Health Service prove beyond question the truth of this proposition.

Doctor GARRISON. May I ask the name of the biologic house that is putting out that preparation?

Doctor MCCORMACK. Lederle; and it passes through the Bureau of Animal Industry.

Doctor **Welch.** It is standardized, is it?

Doctor **McCormack.** It is standardized.

Doctor **Schereschewsky.** Is there any further discussion? If not, I will ask Doctor Stimson to close.

Doctor **Stimson.** I am glad the subject of coyotes was mentioned, because I suppose there are comparatively few people bitten directly by coyotes. They are bitten by dogs, which in turn were bitten by coyotes. If dogs were immunized they would not have become rabid and the bites would not have caused rabies.

Doctor **Welsh.** Where do you introduce the virus?

Doctor **Stimson.** Under the skin; it is subcutaneous.

There is one thing I did not mention, and that is that in any campaign against rabies there have got to be taken into account the wandering and ownerless dogs; but how are you going to tell the wandering and ownerless dogs? They used to send out and kill all wandering dogs having no collar on or evidence of the owner, but in some sections of the country it is not practical to do that, and in others it is not safe.

It is possible, if the immunized dog could be identified by some sort of fairly conspicuous tag, showing he was immunized, it would render the problem of dealing with ownerless dogs a little easier, because after this campaign is pushed through the country to get people to immunize their dogs, and they have been told about it, you would have greater justification for killing off the wandering population of dogs, which will be a menace until it is controlled.

Doctor **Schereschewsky.** Is there any further discussion? If not, I declare this twentieth annual conference of the State and Territorial Health Officers of the United States Public Health Service is concluded.

The Chair speaks for the Surgeon General, who is unavoidably absent, and thanks you for your attention, and hopes this conference will be as productive of valuable results as the conferences have been in the past.

A motion to adjourn will be in order.

(A motion was made to adjourn, which was duly seconded and carried, and the conference of the State and Territorial Health Officers with the United States Public Health Service adjourned at 5 o'clock.)

ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
15 CENTS PER COPY
▽

TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 129
DECEMBER, 1922

COMMUNICABLE DISEASES AND TRAVEL

By

THOMAS R. CROWDER, M. D.

PREPARED BY DIRECTION OF THE SURGEON GENERAL

WASHINGTON
GOVERNMENT PRINTING OFFICE
1922

CONTENTS.

Page.

Introduction v

The communicable diseases 1

    Methods of transmission 1

    Importance of contact 3

    Carriers and missed cases 5

Transportation of persons having communicable diseases 7

    Travel of unknown cases 7

    Travel of known cases 9

    Persons forbidden to travel 10

    Restricted travel 13

        Acute sputum-borne diseases 16

        Acute feces and urine borne diseases 22

        Pulmonary tuberculosis 27

            Extent of tuberculous travel 28

            Modes of tuberculous infection 31

            Extent of tuberculous infection 34

            Genesis of tuberculous disease 34

            Dangers of tuberculous travel 36

            Regulation of tuberculous travel 40

        Leprosy 43

        Venereal diseases 45

        Miscellaneous diseases 48

    Cases discovered en route 51

    Conveyances vacated by infected persons 53

INTRODUCTION.

Man's wanderings from place to place are largely responsible for the spread of disease. Almost without exception dangerous communicable maladies are carried by man or by small animals closely associated with him. Great epidemics of the past in which hundreds of thousands perished have often been transmitted through religious and other pilgrimages. In olden times when means of transportation were primitive and travel slow and infrequent disease appearing in one section of a country did not have the immediate significance for every part of the world that it now has. In these days of frequent and swiftly moving railway trains, airships, airplanes, and steamships carrying thousands of souls, the situation has completely changed. An outbreak of smallpox or cholera anywhere is of immediate concern to the entire world.

Fortunately the weapons are at hand to cope with the problem. The development of medical science has made it possible to control communicable diseases in spite of the difficulties introduced by modern transportation facilities. Disease control as affected by railway and steamship travel has become a specialized branch of sanitation in which practices are rapidly becoming standardized. Until recently the 48 States of the Union had nearly as many different sets of sanitary regulations as there were States. These are now gradually giving way to a commonly accepted standard. The principles governing the practice of railway and steamship sanitation are thoroughly discussed in this pamphlet by one who has had many years of experience and training in that special field.

One of the most important principles to be kept in mind is the necessity for obtaining the maximum result with the minimum interference with travel. Quarantine has ever been unpopular. Thanks to the rapid strides which have been made in preventive medicine, it is now seldom necessary to require detention extending over a period of many days. In the light of our knowledge fomites and inanimate objects can be almost entirely disregarded. It has been well said that dangerous communicable diseases usually "travel on legs." In other words, disease is conveyed by human carriers, by insects, or by other living intermediaries. These are controllable and how it can be done is well set forth in this pamphlet.

Successful disease control depends largely on education of the public, and particularly on the education of those who have the direction of the traveling public. Doctor Crowder's work will be of great assistance in that education.

VICTOR G. HEISER,
Surgeon, United States Public Health Service.

NOVEMBER 6, 1922.

COMMUNICABLE DISEASES AND TRAVEL.

THE COMMUNICABLE DISEASES.

Communicable diseases are of many kinds, but they have some things in common: They are all caused by living organisms growing as parasites in the bodies of affected persons; they are transmitted only by a material transfer of the causative organism, which must be still alive and virulent; and each case comes from a previous case of the same kind. An epidemic or an outbreak is only a continuing chain of infection. In a few diseases only it may pass from animals to man; but most of the communicable diseases of man are peculiar to man alone, and if we could make impossible any transfer of the causative organisms from infected to well persons, the infecting chains could not be formed and the infection could not go on.

These facts are fundamental to communicable disease control. The sanitarian tries to destroy the links of the connecting chains of infection. In order to succeed, he must know where the origin is and how the links are formed. In some of the communicable diseases we know in great detail just where the contacts lie and how the infection passes. There may be only a single way of linking one case with another, as through the bite of an insect, in which case the means of prevention are clear. In others, while we know the causative organism, where it exists in the body, and how it is shed off, there are a multitude of possible routes by which it may reach a second person, and prevention is correspondingly complex and difficult. In others still, there are many obscurities; for neither the causative organism nor the ways of its transference have been accurately determined, and we can deal with them only by their analogies to diseases which are better known. Many times these analogies are so clear as to leave little doubt of the general facts concerning transmission, but there will always remain some uncertainty until further studies have given us more definite knowledge.

METHODS OF TRANSMISSION.

Everyone is familiar with the old belief that diseases are contracted from filth, foul air, effluvia, and the miasmas arising from swamps. Even yet many people believe this, though there is no longer any excuse for their doing so except ignorance of ascertained facts. Yellow fever was long looked upon as a perfect example of contagion from filth and effluvia; in no other case was the demonstration apparently so clear; and the most elaborate precautions were taken in subjecting to renovating processes baggage and cargoes from infected ports. It is even said that an assiduous quarantine officer once deemed it necessary to disinfect a barrel of carbolic acid. But now we know that yellow fever is conveyed by the bite of a particular kind of mosquito after feeding on the blood of a yellow-fever patient, and in no other way. Baggage, old clothes, or filth of any sort have nothing to do with it, except in so far as they may be resting places for mosquitoes, and the most rigid cleanliness is of no avail if the infected mosquito is allowed to be abroad. Malaria was the basis of our belief in the miasmatic origin of disease, and here, too, the proof seemed to be conclusive; but we now know that the malarial miasma is nothing more intangible than another kind of mosquito, after it has sucked the blood of a person who has malaria. The disease is conveyed by the bite of the mosquito and is not in nature conveyed in any other way. All this has been so clearly demonstrated by numerous experiments that it admits of no further doubt; and if we could destroy all the mosquitoes of the varieties concerned, there could be no more cases of either of these diseases. In the same way it has been shown that plague is transmitted by fleas, typhus fever by body lice, Rocky Mountain spotted fever by a certain species of tick, and a few other diseases by still other insects.

But most of the infectious diseases have modes of transmission that are more direct, and if insects play a part it is incidental and not essential. In such diseases as typhoid, cholera, and dysentery the causative organisms are discharged from the body with the feces and the urine, and the diseases are contracted by the ingestion of food or drink which has become contaminated with these discharges, or by getting into the mouth anything which has been soiled by them. The common fly may be concerned in this contamination, but only by carrying infectious filth mechanically and depositing it on our food. In another group the secretions from the mouth, nose, and throat contain the organisms, and the diseases are transmitted by these bacteria-laden discharges when they are conveyed to the mouths or respiratory passages of other individuals. These are the sputum-borne diseases—a large and important group which includes most of the diseases commonly known as contagious. In yet another group—the venereal diseases—the infecting agents are found in the genital secretions or in discharges from genital lesions, and the diseases are conveyed to other people as a rule by these discharges. In a few communicable diseases the causative organisms are given off in the discharges from open sores, and the diseases are transmitted by such discharges finding their way into scratches, cuts or abrasions on the bodies of other persons.

Even after it became known that the so-called contagious diseases are caused by living bacteria, it was still supposed that external objects play a large part in their transmission: that houses become infected; that books, old clothes, beds, carpets, and furniture harbor the organisms indefinitely and transmit disease through the air after days or weeks or months; that filth and refuse, and the soil, are favorable culture grounds for disease germs and are potent agencies in keeping infections going. Thanks largely to the work of Chapin[1] in collecting and interpreting the evidence, we now know that these things are of very minor significance. There is no longer any reason to believe that the vast majority of disease-producing bacteria develop apart from their human host under ordinary conditions, or that any of them, even under the most favorable circumstances, have more than a very limited growth outside the body. In the main they are obligate parasites; that is, they grow and reproduce themselves only in the favorable soil of the secretions or tissues of the body of their host. Furthermore, it has been proved that the bacteria of most of the infectious diseases die off quickly under the influence of drying and light, and have but a short life when discharged from their natural soil in the body. Objects that are infected with disease-producing bacteria are capable, therefore, of transmitting disease for only a short time; and then only by such intimate contact as will bring about the transference of their contained or adherent organisms into the bodies of new individuals, by the hands or in other ways. For bacteria are solid bodies, with weight and substance; they can not fly about of their own accord or travel through the air unaided; they go only where they are mechanically carried.

IMPORTANCE OF CONTACT.

With the exception of the diseases that are conveyed by insects and the few that are commonly borne by contaminated water or milk, the accumulating evidence is making it more and more evident that the majority of transmissible infections are passed with relative directness from one person to another. Just as we were long ago compelled by increasing knowledge to give up leaky plumbing, sewer gas and rotten potatoes as original causes of communicable diseases, so are we now compelled to give up analogous things as agents of their transmission. The facts all point toward the relative unimportance of the environment, and toward the relative importance of the infected human agent. We are coming to understand that people themselves are the chief agents of disease transmission as well as the only sources of infection, and that the thing of most importance is the actual presence of the infected person. The most frequent way in which his infection is passed on to another is through the relatively short and direct channel of contact. It should be emphasized here that simple proximity is of relatively small importance. Approach may be very near and still be entirely free from danger if no contact is established.

---

[1] Chapin, Sources and Modes of Infection, N. Y., 1912.

But contact in this sense, and as now commonly used in discussions of public hygiene, means more than actual touch between persons. It means rather contact with infected secretions while they are still fresh and virulent, whether still on the person who produces them or on things that he has soiled, its essential feature being that it is nearly related in time and space to the escape of the infecting agents from the infected body. But contact alone, as of the hands, with disease-producing bacteria is not sufficient to bring about disease-producing infection; the organisms must find their way into the bodies of their new victims. As a rule they can not enter through the intact skin. They must be implanted on a moist mucous membrane, directly by the fingers, or with food and drink, or in some other way, before they can produce a disease.

Contact infection of the form referred to may be brought about in many ways. Its classical example is found in the mouth to mouth contact of kissing, but others which are less direct are in the aggregate vastly more important. When we cough, or sneeze, or speak very loud, we expel a finely divided and invisible spray of the secretions of the mouth or respiratory passages into the air about the face. Unless borne up by currents of air this spray is not carried more than a few feet, and it rapidly settles upon the floor or surrounding objects where bacteria soon die; but if someone stands near enough to breathe immediately into his lungs our spray-laden expelled air, he may breathe in also the droplets that we have expelled and may get such infections as we have. It should be emphasized, however, that this danger disappears in quiet breathing, for the quietly expired breath contains neither droplets nor bacteria. When we drink from a cup we leave a little saliva on the rim; another drinking may swallow our bacteria, which, if they have not dried, will certainly still be virulent and readily detached. Fingers soiled with urine or feces containing typhoid bacilli may be carried to the lips, or in handling food for another's consumption may contaminate the food and transmit typhoid fever. Sputum deposited on the floor may get onto the hands and be carried to the mouth, or it may be carried away on the shoe soles and deposited elsewhere for the soiling of other hands. The practice of sneezing into the hands or blowing the nose through the fingers always contaminates the hands with nasal secretions, and shaking hands with another person may transfer to him an unseen but still an infectious portion of such secretions. A child may mouth a toy which has touched an infected hand, or which has been picked up from a floor where infected sputum lies.

These are only a few of the ways by which contact may be established. The hands are the most frequent offenders. Few people realize the multiple activities of their hands, or the number of times they touch foreign objects and their own lips and noses. A recent record by Palmer[2] showed in a single ordinary day 92 opportunities for infecting his own hands directly by contact with other hands or with articles just handled by others, 14 opportunities for infecting himself from his own hands by carrying them to the nose or mouth, and 17 opportunities by carrying to his mouth articles possibly infected by others. This is probably not more than is usual for normally active people. According to Rosenau,[3] probably 90 per cent of all infections are taken into the body by the mouth from the hands with food and drink, by the droplets expelled in coughing, or directly by kissing and fondling.

The essential factor in the prevention of communicable diseases is, then, the supervision of individuals having disease germs. Their bodily wastes and discharges must be so disposed of that they will not contaminate the air or the food or the drink that is to be taken into the bodies of other individuals; but chiefly they must be so restrained that they can not transmit their bacteria to healthy people by direct or indirect contact. The proof of the importance of contact has brought about great changes in methods for the control of communicable diseases. It has directed attention to the individual and his habits and away from the condition of his surroundings. While this has made the matter simpler, by narrowing the target at which efforts must be aimed, it has scarcely made the problem easier of solution; for to control the habits of the individual to the end that he may not contaminate with his secretions the things that are about him is a very difficult matter.

CARRIERS AND MISSED CASES.

Along with the demonstration of the part played by contact with ill persons in the transmission of the communicable diseases, we have also learned that there are many infected persons who are not sick, and others who are only so slightly ill that their infections are not suspected. These "carriers" and "missed cases" complicate the problems of prevention enormously. They are potential sources of new cases of actual disease, just as are the cases already sick and identified; and they play a large part in keeping infections going, because they usually fail to come under sanitary supervision.

---

[2] Palmer, Opportunities for Contact Infection, Amer. Jour. Public Health, April, 1919, ix, 267.

[3] Rosenau, Preventive Medicine and Hygiene, N. Y., 1916, p. 366.

According to their relation to cases of actual illness, there are carriers of two kinds, which have been classified[4] as active and passive. An active carrier is one who has passed through and recovered from a disease but who has failed to shed all of his infecting organisms. Most cases of infectious diseases remain active carriers for a short time after clinical recovery, some of them remain so for long periods, and a few become permanent, or chronic carriers, continuing to be a menace and a source of infection to well persons. Missed cases act in this regard like those who are acutely sick. A passive carrier is one who harbors in his body the virulent organisms of a disease from which he has never suffered any illness—who has become infected, and in whose body the infecting organisms grow, but whose resistance or natural immunity is so high that the infection does not cause the development of a disease. Under like circumstances we are all about equally liable to infection; that is, to the getting of disease germs into our bodies; but individual resistance and susceptibility vary in a high degree, so that from a given infection one person may develop a disease while another may only become a passive carrier of disease germs, and another still may throw off the germs entirely. Passive carriers are not infrequently found among those who are in close association with an acute case of a communicable disease.

Like the active carriers, they may soon become rid of their germs and return to the normal state; but some of them continue to harbor and expel dangerous organisms through long periods; and it sometimes happens that they themselves later fall victims to the very organisms which they have long harbored without harm and develop the diseases which these organisms cause.

As knowledge of carriers has developed it has become apparent that there are many of them, but the number varies greatly in different diseases. It has long been known that a large proportion of the people, from 20 to 50 per cent of them, have pneumococci in their mouths. While many of these pneumococci have little or no virulence, many are known to be highly virulent and quite capable of producing disease in an experimental way. "During outbreaks of cerebrospinal meningitis the number of carriers may be from 10 to 30 times as numerous as the number of cases. Even when diphtheria is not prevalent 1 per cent of the population may be carrying the bacilli, and during outbreaks the number may be several times greater. Probably 25 per cent of all typhoid fever cases excrete bacilli for some weeks after convalescence, and it is estimated that from 1 in 500 to 1 in 250 of the population are chronic carriers. What little evidence there is indicates that carriers are as numerous in cholera and dysentery [in those regions where these diseases are endemic] as they are in typhoid fever."[5] In malaria, carriers are known to be very numerous, and a considerable proportion of the cases of venereal diseases become chronic and remain infectious for a long time. At the other extreme are measles and smallpox, where the evidence seems to show that the carrier state is rare.

---

[4] Simon, Human Infection Carriers, Philadelphia, 1919.

While we have not enough evidence to show clearly just what is the relative importance of carriers and of sick cases in the spread of the communicable diseases, there is ample epidemiologic evidence that healthy carriers may be the source of well marked outbreaks of some of the most common of them. And, as Chapin says, "any scheme of ultimate control which fails to take into consideration carriers and missed cases is doomed to at least partial failure." A practical plan to discover and cure carriers is indeed one of the most urgent needs of sanitary science at this time. The railroads can neither discover them nor prevent their traveling.

TRANSPORTATION OF PERSONS HAVING COMMUNICABLE DISEASES.

The control of communicable diseases on the railways does not differ in its essential features from their control in other places. It involves (1) supervision of the person who is known to be infected, either by preventing his traveling, or by such measures as will render his presence on a train harmless to others; (2) such measures of cleanliness and general hygiene as will render unlikely the indirect transfer of unknown infection among travelers to healthy persons through the medium of such things as towels, drinking cups, and other objects of personal or common use; (3) the control of food and water supplied on trains and at stations, to the end of assuring their freedom from contamination with disease-producing bacteria from the secretions of infected people.

TRAVEL OF UNKNOWN CASES.

Obviously, when food and water have been made safe, the simplest and most direct plan of further protecting those who travel is to keep out of cars all persons who are infected with the organisms of communicable diseases. The difficulty in applying such a plan is in knowing who is infected. Patients in the early stages of measles, whooping cough, scarlet fever, etc., before evident symptoms have developed and before the patients are actually ill, may enter trains and reach their journey's end without anyone—fellow travelers, railroad employees, or sometimes even the patients themselves—being aware of their condition. People who have recently been exposed to some acute infection may have strong grounds for believing that they are coming down with the disease, yet may undertake railroad journeys without regard to the possible danger to fellow passengers. Or patients in whom a definite diagnosis of a communicable disease has been made may successfully conceal their symptoms and travel without recognition, sometimes even with the consent of their physicians, thus duplicating a situation that often exists in cities when people are selfish and short-sighted enough to conceal cases developing in their homes for fear of the inconvenience incurred through quarantine. Just as the control of communicable diseases in cities is largely dependent on the conscientious reporting of cases. so, too, on the railroads their control depends largely on the conscience of the patients who wish to travel.

---

[5] Chapin, Sources and Modes of Infection, 1912, p. 132.

How many of these various cases are carried, and what harm each case has done, is of course unknown. While their number in the aggregate may be large, they can not be more than a very small proportion of the total of railway travelers. And whatever hazard of communicable diseases they hold for well persons with whom they come in contact is by no means peculiar to railroad travel, but exists to the same extent in all public places where people assemble. The railroads themselves are powerless to prevent such patients from traveling. They are bound by law to furnish transportation to those who ask for it, and they have little power to discriminate among those who may apply. It is not possible for them to refuse accommodation except under well-defined conditions, which, in so far as the communicable diseases are concerned, must include a definite diagnosis; and this the railroads can scarcely be prepared to make under the ordinary conditions of travel. Their employees can have but slight knowledge of the symptoms of such diseases; and yet the public health laws and sanitary regulations of some of the States are so framed as to put on the railways and railway employees the whole responsibility for preventing travel on trains of persons suffering from communicable diseases. This makes the regulations worthless from a practical standpoint, or of value only in cases where the symptoms are so evident that doubt is impossible; and under such circumstances there is little likelihood of any attempt being made to travel.

While it is entirely proper that the railroads should not knowingly accept cases of communicable diseases for travel unless properly safeguarded, and that laws should embody this idea, yet legal regulation should also fix the responsibility where it really belongs; that is, upon the traveler who knows or suspects that he is infected. In the nature of things he is the one most likely to be informed. and regulations should make it unlawful for him to apply for or accept transportation unless his disease is properly announced and safeguarded. It is scarcely necessary to add that the same conditions should apply to the parents or guardians of children who are ill, or to anyone in charge of a patient afflicted with a dangerous communicable disease.

Legislation to this purpose has been passed in one form or another in many of the States and has been embodied in the interstate quarantine regulations of the Federal Government, but there has been little concerted effort to enforce its provisions or to make them generally known. The regulatory measures should be extended and made uniform, so that all parts of the country may have similar practices. When a uniform code is adopted it should be extensively printed and distributed, so that both railway patrons and railway employees may learn of the conditions under which travel is permitted and know how to comply with the conditions imposed. It is not to be supposed that compliance will be universal, even if everyone is informed, but regulations in this matter may have a definite and considerable restraining value if their provisions are made known to and impressed upon the public. In all administrative efforts to control communicable diseases success is won slowly and is largely dependent on the general diffusion of knowledge concerning what is the right thing to do.

There will remain the uncontrolled and uncontrollable travel of carriers—uncontrollable because under present conditions they are largely unknowable. The general teaching of habits of personal care regarding the disposal of bodily wastes, especially the secretions of the nose, mouth, and respiratory tract, will do something to lessen their danger in railway cars as elsewhere. The importance of such habits in the practical prevention of respiratory diseases is so well demonstrated that unusual emphasis upon the proper disposal of sputum has become an essential element in all effective public health administration. Railway travel necessarily involves a considerable amount of personal proximity among a miscellaneous group of persons. They should all be informed regarding droplet infection from coughing and sneezing, as well as regarding the various modes of direct and indirect contact infection; and they should all learn that at least some cases of infectious diseases may be prevented by smothering coughs in handkerchiefs, by spitting only in cuspidors, and by maintaining sputum-free hands and surroundings. Such teaching can not by any possibility do harm and it may, if effectively followed, do much good.

TRAVEL OF KNOWN CASES.

The railroads are sometimes called upon to carry patients known to be suffering with communicable diseases, and there often seem to be good reasons why they should do so. Should transportation be refused to all such cases, or can their transportation be so safeguarded that there is no danger to other passengers?

In the present state of our knowledge of the routes of infection and methods of prevention, it is theoretically possible to safeguard a known case of any disease so that its transport will be safe. Practically, however, it is desirable to make exceptions, and to say of certain diseases that they may travel under restrictions while others may not travel at all. There have been differences of opinion among public health authorities, and more among law makers, as to just what diseases should be included in this forbidden group; and the regulatory measures have been various in consequence. Some States have included all communicable diseases, without name or qualification; others have included by name most of the common infections; while others have shorter lists, with sometimes strange combinations. Indeed, there is little harmony or agreement in the laws of the various States on any of the phases of communicable disease control, as evidenced by the fact that the number of diseases which they designate as "dangerous to the public health" and bring under any kind of regulation varies from more than 50 to less than 10.

PERSONS FORBIDDEN TO TRAVEL.

While the tendency of the State laws has been toward a very broad prohibition of travel by persons with infectious diseases, there has been great dissimilarity in the methods devised to make their control effective. In an analysis of the laws and regulations concerning the communicable diseases made by Kerr and Moll [6] in 1913 the legal restrictions of travel were found to be as follows:

> Traveling of persons with communicable diseases is specificially forbidden in some States,[7] and in others [8] unless authorized by the health authorities. In some States the transportation of such persons is prohibited,[9] or it is made punishable to bring them into the State.[10] In others, their being put on board any train or public conveyance,[11] or their going from one town to another is prohibited,[12] one State board of health [13] being specifically authorized to restrain or prohibit travel of persons with communicable diseases on public conveyances. Persons with communicable diseases are forbidden to enter public conveyances in many States either absolutely [14] or unless they make known the fact to the owner or driver, who must disinfect the conveyance immediately after such occupancy.[15] In other States, by regulations of State boards of health, persons from infected premises are forbidden to enter public conveyances,[16] or persons who have visited such premises before entering conveyances must disinfect

---

[6] Kerr and Moll, Public Health Bulletin No. 62, Government Printing Office, Washington, 1914.

[7] Indiana, Kansas, Mississippi.

[8] Kentucky.

[9] Indiana, Kansas, New Jersey, South Carolina, Texas, Wisconsin.

[10] Michigan, Oregon.

[11] Iowa.

[12] Vermont, Virginia.

[13] Montana.

[14] Arizona, Connecticut, Florida, Georgia, Idaho, Indiana, Kentucky, Michigan, Minnesota, Montana, New Jersey, North Dakota, Ohio, Oregon, Pennsylvania, South Dakota, Tennessee, Texas, Utah, Washington, Wisconsin.

[15] District of Columbia, Louisiana, Maine, Maryland, Pennsylvania.

[16] Illinois, North Dakota.

their clothes and obtain the permission of the health authorities.[17] * * * Persons coming from infected territory may, by express authority in law, be restrained from traveling by local health authorities in many States;[18] while in various States it is specifically provided that removal of infected or exposed persons from place to place can only be made with the consent of the local health authorities,[19] or either the State or local health authorities.[20]

Since this analysis was made there have been some changes and additions which invalidate the quoted summary as a guide to legal action; these will be referred to later; but to a large extent the matter stands now as it did then, State laws remaining variable and inharmonious when they should be uniform. Health and diseases do not recognize State limits; neither should the regulations which seek to control them change when these limits are passed. Even health officers have not encyclopedic minds for sanitary law, and we can scarcely expect of travelers and transportation agents that they will learn a new set of sanitary rules each time they cross a State border. It is true that the National Government may, and to some extent actually does, regulate interstate quarantine; but under our system of government the State must remain the chief legislative unit, and only when State enactments become uniform may we hope for the development of such a general knowledge of quarantine regulations as will ultimately lead to general compliance with them as they apply to railroad travel.

It is not a matter to be decided offhand just which diseases should be forbidden on trains and which ones should be permitted under proper restrictions; but there should be some rule adopted which is possible of general application, with an attempt to harmonize under the well-established principles of sanitary science the interests of the railroads, the traveling public, and at the same time to preserve the public health. I believe these conditions are met by excluding from travel persons ill with any of the major quarantinable diseases—plague, cholera, yellow fever, typhus fever, and smallpox—and allowing those ill with other diseases to travel under proper supervision. The five diseases named should be excluded from travel because, first, they are (with the exception of smallpox) not commonly present in this country, but when once started in a community have enormous possibilities of epidemic spread; second, their presence is excessively disturbing to the public peace of mind; third, they are known throughout the world as the major quarantinable diseases and are subjected to detention wherever they may be found.

---

[17] Kentucky, South Dakota.

[18] Alabama, Colorado, Florida, Maine, Massachusetts, Michigan, New Mexico, North Carolina, Washington, etc.

[19] Colorado, District of Columbia, Louisiana.

[20] Arizona, North Dakota, South Dakota.

Most of the communicable diseases which are commonly known at large we have everywhere, and to some extent all the time. It is so with diphtheria, measles, scarlet fever, typhoid fever, pulmonary tuberculosis, and others. They are endemic. A case more or less is important enough, but it brings no new factor into the public health problem as a rule. Health officers and the public are accustomed to dealing with them and do not become excited over them. It is not so with plague, cholera, yellow fever, and typhus fever To introduce a case of one of these into any community in the United States is to introduce an entirely new public health problem and to interfere in many ways with commercial and social activities. They are, furthermore, acute and violent infections which soon come to an end, either by recovery or death; and at whatever expense of time or trouble to the community, or of discomfort and unhappiness to the patient and his friends, they are best cared for by isolation in the community where they are first discovered and as near the point of origin as is reasonably possible.

It is not because the four diseases referred to can not be transported safely that they should be forbidden to travel, but because they are so disturbing during the journey and on arrival in a new community. We know in great detail how the causative organism for each of them passes from person to person and the means which are necessary to prevent their spread. Plague (except the pneumonic type) is transmitted by the bite of an infected rat-flea, yellow fever by the stegomyia mosquito, and typhus fever by the body louse. No fleas, no bubonic plague; no mosquitoes, no yellow fever; no lice, no typhus fever. If we can be perfectly sure that the patient and his quarters are entirely free from the insects concerned, and that none will by any chance gain access to him, the protection of other people is assured. Being perfectly sure of this is of course a task involving difficulties and the most painstaking care, with always the possibility of something going wrong; but with sufficient care the danger may be entirely overcome. Cholera is transmitted by the vomit and alvine discharges, through contact, or water, or food; and the obvious means of preventing its spread is the prompt and perfect disinfection of vomitus and feces. With this assured the cholera patient might travel without doing harm. But as with plague, yellow fever, and typhus fever, the disease is normally foreign to our shores; our only experience of it is that of disastrous epidemics; and if it is introduced at all it should be strictly held in place until all danger of transmission to other people is past.

Smallpox, on the other hand, is an endemic disease, and most communities are in some degree prepared to deal with it; but it is acute and serious, is known to be very readily communicated, and there is no disease more capable of disturbing the public mind.

Furthermore, we do not know the causative organism, nor precisely the mode of its transfer. We are therefore relatively ill equipped to prevent transmission of smallpx infection to susceptible individuals. It is beside the mark to say that except for ignorance, neglect, and the misguided opposition of the antivaccinationists we should have no susceptibles to smallpox, since in vaccination we have a safe and nearly perfect prophylactic. With rigid rules for universal vaccination the disease would no doubt practically disappear; but under present conditions there will remain enough susceptibles so that no community can feel safe while smallpox is about, and as long as this is the case the disease should be excluded from railway travel.

A move toward uniform regulations, embodying the program suggested above, was made in May, 1920, when a "Standard Railway Sanitary Code" was approved by the Conference of State and Provincial Health Authorities of North America and recommended by the conference to the several States for adoption as a part of their sanitary regulations—a program which was later approved by the United States Public Health Service in conference with the health officers of the States. That code prohibits entirely[21] the travel on railway trains of plague, cholera, yellow fever, typhus fever, and smallpox, and allows other communicable diseases to travel under very strict supervision. Twenty States[22] have already officially adopted the standard code as a part of the State sanitary regulations, and many State health officers have signified their intention of taking similar action. The essential provisions of the standard code have also been incorporated in the last revision of the Interstate Quarantine Regulations, issued in May, 1921, which apply to all travel from one State into another, so that uniform provisions concerning the travel of communicable diseases now have a very wide application.

RESTRICTED TRAVEL.

As already stated in the preceding section, except as recently altered by the adoption of the Standard Railway Sanitary Code the regulatory measures of the States concerning the travel of communicable diseases have been chiefly of a prohibitive nature. In many States the prohibitions have been written into the statutory law. As new knowledge is acquired it should be possible for some small body of experts to apply it at once by a change in the regulations, without waiting for a legislature to meet or to convince its members, often ill informed on scientific matters, what administrative measures the public health requires. To change a law is always a difficult thing;

---

[21] Sections 1 and 2 of the Standard Code. See Appendix.

[22] Alabama, Florida, Georgia, Illinois, Kansas, Kentucky, Louisana, Maine, Maryland, Michigan, Minnesota, Mississippi, New Hampshire, North Dakota, South Carolina, Tennessee, Virginia, West Virginia, Washington, Wisconsin.

for a State board of health to change a regulation is relatively very simple, and all necessary power to make public health regulations should be delegated to them. Great harm is sometimes done, and antiquated rules—generally more honored in the breach than in the observance—are often kept in force because sanitary codes are enacted into law.

It is only since 1916, when the United States Public Health Service first officially recognized the occasional necessity for the travel of communicable diseases and attempted by means of the Interstate Quarantine Regulations to put proper safeguards about it, that any of the States have modified the prohibitive provisions of their sanitary codes. A few States soon followed the interstate lead. In 1917 the Oklahoma Board of Health passed regulations which specify restrictions under which many communicable diseases may be accepted for transportation, following closely but not quite duplicating the interstate regulations made in the previous year. At about the same time the Washington State Board of Health adopted the Interstate Quarantine Regulations in their entirety; and Kansas and Montana followed with rules which were the same so far as this portion of them is concerned. Early in 1920 the North Dakota board also adopted the Interstate Quarantine Regulations. In the case of Washington and North Dakota, however, old rules were left in force which prohibited entirely the travel of some diseases which the interstate regulations provided for, leaving the actual conditions there in more than a little doubt. But at any rate the attempt of the Public Health Service to solve a difficult problem started a movement away from strictly prohibitive measures which the action of the Conference of State Health Authorities in approving a Standard Railway Sanitary Code and recommending it to the various States for adoption has recently carried far forward.

It is wise to discourage the travel of those who are ill of the communicable diseases, both for the good of the public health and for the good of the patients themselves. For those who are seriously sick any considerable journey may involve no little danger, a fact which is fortunately so well recognized as largely to deter them from any attempt at travel in the acute stages of their afflictions. But there are sometimes good reasons why travel should be undertaken if the condition of the patient will allow, of which the following are examples: A child falls ill of scarlet fever, measles, or whooping cough, and his parents are anxious to bring him home where they can care for him, and also to avoid the danger of contagion to the children where he is visiting. A laborer in a mining camp where there is no hospital, doctor, or nurse, and where there is great danger of spreading the infection, develops typhoid fever, and the manager of the camp wishes to send him to a hospital where he can have skilled care. A patient with pulmonary tuberculosis wishes to go to a distant sanitarium in search of a cure; or being fatally ill and realizing that his journey in quest of health has been in vain, wants to end his days at home. A person is discovered to have leprosy, and the health authorities wish to send him to a seaport for deportation, if he is an alien, or, if a citizen, to a distant hospital for proper isolation and care.

If provision is not made for such cases as these they will travel anyway, without regard to prohibitive laws, and generally without the safeguards that should always be required. And they ought to be allowed to travel under conditions that will make their travel safe for themselves and for other passengers. Practically the number of such patients, except those with tuberculosis, will always be very small, but their proper disposal is important. There is no doubt that adequate safeguards can be applied, though under present conditions very few transportation agents and practically no passengers understand what they are.

The measures necessary to make safe the transportation of persons with communicable diseases will vary according to the particular disease concerned, being determined by the way in which the infecting agent is transmitted from one person to another, by the virulence of the disease, and by the readiness with which transmission can take place. They may include any or all of the following:

(1) Isolation of the patient in a compartment separate from other passengers.

(2) The care of a responsible personal attendant.

(3) The disinfection of bodily discharges.

(4) The disinfection of eating and drinking utensils.

(5) Provision by the patient or his attendant of special facilities for carrying out these measures of disinfection and for preventing gross contamination of the car and its contents.

It is usual to classify the communicable diseases according to the ways in which their causative organisms are transmitted from one person to another. We may, however, for the practical purposes of an inquiry into the safeguards of transportation, depart from any strictly logical or all-inclusive classification and divide them for convenience into the following groups:

1. Acute sputum-borne diseases.
2. Acute feces and urine borne diseases.
3. Pulmonary tuberculosis.
4. Leprosy.
5. Venereal diseases.
6. Miscellaneous.

I. ACUTE SPUTUM-BORNE DISEASES.

For the purpose of regulating railway travel the acute sputum-borne diseases should be considered to include diphtheria, measles, scarlet fever, epidemic meningitis, epidemic encephalitis, anterior poliomyelitis, pneumonia, influenza, septic sore throat, rubella, chicken pox, whooping cough, and mumps. In a few of these diseases there are other possible ways of transmission than by the secretions of the mouth and respiratory tract—by the products of skin lesions in chicken pox, for instance, or by discharges from the ear in the complications of scarlet fever—and in a few there may be a reasonable doubt as to the method of transmission, as in epidemic encephalitis; but in most of them the sputum stands clearly convicted of carrying the infecting agent, and in all of them it seems reasonably clear that this is the chief of the means by which they are transmitted from one person to another. He who would understand these diseases correctly must keep this well in mind: That the matter of contracting them is a matter of "swapping spit."

The measures to be taken to prevent the spread of contagion from cases of these diseases must therefore be aimed at preventing the transfer of sputum, whether directly in droplets emitted by the patient in talking, coughing, or sneezing, or indirectly by means of fingers, dishes, eating utensils, and other objects which may be soiled with the sputum or nasal discharges. In order that the necessary details may be effectively carried out, isolation and a personal attendant should always be required.

The Interstate Quarantine Regulations and the Standard Railway Sanitary Code provide for the travel, under restrictions, of all of the diseases included in this group as given above. The appropriate section of the Standard Code, which applies by official adoption in Alabama, Florida, Georgia, Illinois, Kansas, Kentucky, Louisiana, Maine, Maryland, Michigan, Minnesota, Mississippi, New Hampshire, North Dakota, South Carolina, Tennessee, Virginia, West Virginia, Washington, and Wisconsin, reads as follows:

> SEC. 3. *Restricted travel.*—Common carriers shall not accept for transportation on any railway train, car, or other conveyance any person known by them to be afflicted with diphtheria, measles, scarlet fever, epidemic cerebrospinal meningitis, anterior poliomyelitis, mumps, whooping cough, influenza, pneumonia, epidemic encephalitis, septic sore throat, rubella, or chicken pox, or any person known to be a carrier of these diseases, unless such person is placed in a compartment separate from other passengers, is accompanied by a properly qualified nurse or other attendant, and unless such nurse or attendant shall agree to comply and does so comply with the following regulations:
>
> (*a*) Communication with the compartment within which the patient is traveling shall be restricted to the minimum consistent with the proper care and safety of the patient.

(*b*) All dishes and utensils used by the patient shall be placed in a 5 per cent solution of carbolic acid or other fluid of equivalent disinfecting value for at least one hour after they have been used and before being allowed to leave the compartment.

(*c*) All sputum and nasal discharges from the patient shall be received in gauze or paper, which shall be deposited in a paper bag or in a closed vessel, and shall be destroyed by burning.

(*d*) Said nurse or attendant shall, after performing any service to the patient, at once cleanse the hands by washing them in a 2 per cent solution of carbolic acid or other fluid of equivalent disinfecting value.

The requirements of the Interstate Quarantine Regulations, are the practical equivalent of those above quoted; and they apply to the same diseases, with the addition of Rocky Mountain spotted fever and anthrax. They have the added provisions, however, that the patient shall obtain permits from the State or local health authorities at the places of beginning and ending of his journey, and that the attendant shall obligate himself in writing to carry out the requirements. Regulations in effect in Oklahoma and Montana are practically identical with the Interstate Quarantine Regulations, but they omit from the list of diseases influenza, epidemic encephalitis, and mumps, for which no provision is made, and place scarlet fever with those that may not travel at all, thus agreeing with an older form of the Interstate Quarantine Regulations. All the regulations require the disinfection of the space occupied by the patient immediately after it has been vacated.[23]

There is probably good reason for requiring permits from the health authorities at the points of origin and destination. In any event, the health authorities should be notified of the location of every case of communicable disease within their jurisdiction in order that they may make sure that the public is protected and exercise control over the patient; and no physician should allow his patient to travel without proper notification. The question of terminal disinfection will be considered later. The other measures of the above regulations must be taken up in detail, even though it may involve the repetition of much that is obvious.

1. *Isolation.*—The patient should be placed in a separate compartment entirely closed off from other passengers, and with which only such communication is permitted as is absolutely necessary for his care. This compartment should have separate washing and toilet facilities. The drawing room of a sleeping car fulfills these requirements in detail, having a toilet and wash room directly connected with it. A compartment in a sleeping car or parlor car will also answer well, but is less desirable because of less adequate toilet facilities.

The question arises, however, as to what shall be done when there is no drawing-room or compartment in the train. Theoretically it might be made safe to carry the patient in the body of a sleeping car, in a berth with the curtains hung, where the proper disposal of a few clean sheets will make an effective cubicle; but practically this method can not be carried out with entire safety or without undue annoyance and alarm to other passengers. In some cases where the need for transporting a patient has been very great and other facilities were not available, a baggage car in which a cot has been curtained or screened off has been used. It may be made to answer for short distances only. An empty coach could be used in the same way, but the cost under ordinary tariffs would be equivalent to supplying a private car, and would usually be prohibitive. In general, and for all journeys of considerable length, the private rooms of sleeping cars and parlor cars are the only practical means of maintaining during travel the strict isolation which is demanded. They are generally to be had where the necessity for a long journey exists; and when they are not available it should be considered inadvisable to transport a case of any of the acute sputum-borne diseases.

---

[23] Standard Code, sec. 10; Interstate Quarantine Regulations, sec. 10. See Appendix.

Attention must be given to getting the patient into the place assigned to him. If very ill, so that he has to be carried on a stretcher, the only way to get him into a sleeping-car drawing-room or compartment is by passing the stretcher through the window. This is not a matter of much difficulty; but the windows are high and will require either an elevated platform or something to take the place of it, such as a large, flat baggage truck. It must be remembered also that the room has windows on only one side of the car and may be approached from that side only. When the patient is able to sit up and to walk the few steps from the vestibule to his room, he may be brought to the car steps in a wheel chair and assisted in from there by the regular route of entry, or he may be carried in the arms of an attendant. It should be ascertained, before attempting to board, in which end of the car the room is located, and the car should be entered from that end so that traversing the car length may be avoided, with its possible dangers of contact or mouth spray infection. If brought in while other passengers are entering, such contact should be avoided; and it would be well for the patient, while boarding or being put aboard the car, to wear one of the many forms of gauze masks or to wear a handkerchief over his face. In any case, if a sick patient boards a car in the presence of other passengers, and they suspect a contagious disease, alarm may be caused unnecessarily. It is therefore advisable to place the patient aboard either before or after other passengers are admitted when this is possible.

2. *Attendant.*—It is entirely possible to carry out in the private room of a railway car the precautions outlined in the regulations

already quoted. It is of course somewhat difficult and inconvenient, necessitates providing in advance certain utensils and materials, and requires above all the service of a personal attendant to go with and care for the patient. The person who performs this service should have had experience in similar procedures under less trying conditions. An experienced and conscientious trained nurse, or an intelligent and conscientious person working under the direction and supervision of a nurse or a physician, is practically necessary if the measures are to be effective. While attending to or in close contact with the patient it is excellent practice for a nurse to wear a gauze mask, both for her own immediate protection against infection and to guard against the danger of becoming a passive carrier of disease germs.

3. *Care of sputum and nasal discharges.*—The sputum and nasal discharges from patients with sputum-borne diseases contain the causative organisms in large numbers, and their proper disposal is the essential feature of rendering safe the transport of such patients. If they are not properly disposed of—if a patient is allowed to cough and sneeze with an unprotected face, to expectorate carelessly, to contaminate his surroundings with his discharges—there will arise all the opportunities for infection through droplets of mouth spray and through the various methods of direct and indirect contact which constitute the great danger from these diseases. Carelessness not only results in gross contamination of the compartment and its contents but endangers the attendant of acquiring the disease or becoming a passive carrier. Painstaking and exact care in the disposal of sputum is the key to successful control.

All sputum and nasal discharges and discharges from the eye or ear in scarlet fever should be received on gauze or soft paper. These soiled articles should touch nothing but the patient and the nurse's hands, and should be immediately dropped into a vessel containing a disinfectant solution or put into a closed vessel or a strong tight paper bag for future destruction by burning. It is of course impossible to burn waste gauze or paper in the compartment; and if some form of disinfection is not used in place of burning, the attendant must be prepared to remove them when leaving the car and burn them later. Coughs should be smothered in pieces of gauze, to be similarly disposed of. The continuous wearing of a light gauze mask has been proposed. It is, however, a very trying thing for a sick patient to wear a mask all the time, and such a plan will be found impracticable; furthermore a light mask is not a perfect safeguard against the spraying of droplets in hard coughing.

Where the patient is very ill, and is therefore unable to cooperate with the attendant in his care, or where there is copious secretion from the nose, mouth, or ear, travel is inadvisable even under the best conditions and will rarely be attempted. Under such circumstances it is difficult to prevent direct contamination of the pillow or other parts of the bedding unless a rubber sheet is placed under the patient and over the pillow, or a thick pad of absorbent cotton or gauze may answer the purpose as well. If there is need for such protection it should be provided by the attendant and removed with the patient.

Sheets and pillowcases of sleeping cars are of course laundered and sterilized by boiling after each time they are used, so that if they become contaminated it is not of serious moment; but as a part of the general care every effort should be made to prevent their being soiled with secretions, and if any gross soiling takes place they should be immediately removed, placed in a laundry bag or tied into a bundle, and fresh ones substituted. Blankets, mattresses, and pillows are all completely incased in clean linen each time they are used; and if protected with reasonable care should not become dangerous as carriers of infection. The question of their care, with that of the room, after the patient vacates the compartment, will be considered later.

4. *Disinfection of eating and drinking utensils.*—Any dish, table utensil, or drinking vessel that has been used by a patient with a sputum-borne disease should be thoroughly disinfected before it is used by another person, because it is very likely to be contaminated by the secretions of the mouth. There is ample evidence that such contamination is common, and that insanitary methods of washing dishes may have an important influence on the spread of epidemics.

Boiling is usually the surest and best way of disinfecting dishes, but it is impractical under the circumstances of traveling. The best method here is immersion in a strong disinfectant solution for an hour after use. For the purpose of carrying out the procedure, the nurse or attendant must be supplied with a vessel of sufficient size and with material for making up the solution.

Dishes and utensils should not be first washed, but should be placed at once in the disinfectant solution. A 5 per cent solution of carbolic acid is effective and reasonably convenient. It is expensive unless the crude carbolic can be obtained. Other solutions of equal disinfecting value which may be used are chlorinated lime, 3 per cent; formalin, 10 per cent; or compound cresol solution, 3 per cent. There are many commercial preparations made from coal-tar cresols which are efficient germicides in 1 to 3 per cent solutions. They are usually inoffensive in odor, have valuable cleansing properties, do not corrode metals, and do not irritate the hands of one using them. Corrosive sublimate, which would be the most convenient disinfectant to use under the circumstances, is not adapted to the purpose, since it combines with albuminous matter to form inert compounds and thereby loses its disinfecting power; it also corrodes metals badly.

Food remnants and gauze or paper used as napkins should be collected with other similar articles and cared for as outlined in the preceding section. It is now possible to provide practically all necessary dishes and drinking utensils of paper. If this is done it will prove a great advantage, for it avoids the necessity of immediate disinfection, since they may be collected and destroyed with other waste materials. Another plan that is useful and results in avoiding a considerable amount of trouble is for the patient to have his own dishes for use during the trip and to which any food brought to the patient is transferred. If service is had from the dining car, arrangements may be made to keep the first set of utensils that is brought for continuous use during the journey. In either such case the disinfection may be dispensed with and replaced by ordinary washing by the attendant, the utensils not being allowed to leave the compartment.

5. *Attendant's hands.*—In caring for the patient and disposing of the secretions, the hands of the attendant will unavoidably become contaminated with the bacteria of the disease. If not thoroughly cleansed at once and made free from infectious material, they will carry bacteria to the things that are handled and to the attendant's mouth. After any attention to the patient the hands should be thoroughly washed in soap and water, then dipped into a disinfectant solution. A 2 per cent carbolic-acid solution, its equivalent of some of the cresol preparations, or a 1 to 1,000 corrosive sublimate solution will answer the purpose. In a sleeping car drawing room or compartment there will be a private bowl for ordinary washing, but an extra basin must be carried for the disinfectant solution. Stress should be laid on the preliminary washing.

Summary and comment.—It is evident that the effective care of cases of the acute sputum-borne diseases during travel on railway trains is somewhat difficult. For that matter their effective care is difficult anywhere and requires essentially the same procedures that have been outlined. The sick room at home or in a hospital must have sick-room facilities and equipment; if we travel with the patient we must take the equipment with him and arrange for the proper use of it. This should be impressed upon those desiring to arrange for the transport of infectious diseases. The steps of the procedures must be made clear beforehand, and the articles which it is necessary to bring to the car with the patient must also be made known. These are, in brief: (1) Pieces of gauze or absorbent paper for collecting discharges and for preventing mouth spray in coughing. (2) A strong paper bag or a closed vessel to receive soiled gauze or paper and other contaminated wastes. (3) A receptacle for disinfecting dishes (unless paper dishes are used). (4) A basin for disinfecting he hands of the attendant. (5) Rubber sheeting for protecting the bedding. (6) Disinfectant for making up solutions for the care of dishes and hands and for the disinfection of secretions.

It may be contended that the proposed regulations are so stringent as to become a practical prohibition of travel by those who are sick with contagious diseases. Certainly they do not make travel easy. They are not intended to do so. They are intended to make it safe, which it must be if it is to be done at all: the precautions of the sick room at home must be continued in the car. But they make travel possible when the need is great; and the procedures required are really simple enough when the principle underlying them is clearly comprehended. They are all directed to the end of breaking the links of contact between the sick and the well, which are formed through the agency of mouth and nasal discharges.

It may also be questioned whether all of the diseases enumerated in this group should be subjected to the same stringent requirements in traveling. Some of them are mild and relatively harmless. Chicken pox, German measles, and mumps, for instance, rarely are dangerous diseases, and in some of the States are not even subjected to quarantine. There is, however, the constant possibility that German measles may be confused with genuine measles, or chicken pox with smallpox, which they sometimes closely resemble. Known cases of even these mild infections should therefore be forbidden to travel on trains in the ordinary way.

The question of influenza is always a difficult one. Its clinical manifestations range all the way from the slight indispositions of common colds to the most serious and profound intoxications. In times of epidemic the disease spreads so rapidly that there can be no doubt of its high contagiousness, and many of the States have placed it in the strictly quarantined class. There will no doubt be many cases going about in many places, but it would nevertheless seem proper to hold the known case strictly isolated and to forbid him the use of space in common with healthy people.

The common colds, the mild sore throats, and the nondisabling common infections of the respiratory tract are also sputum-borne, but it would be worse than useless to attempt to prohibit to those who have them the use of public places or the public means of transportation. Our only practical safeguards against them lie in everlastingly repeating the admonition to cleanly personal habits, especially against the promiscuous distribution of sputum and mouth spray and the careless mouthing of fingers or other things that may be soiled with infectious discharges.

2. ACUTE FECES AND URINE BORNE DISEASES.

The chief diseases of this type are typhoid and paratyphoid fever, the various kinds of dysentery, and cholera. The last has been eliminated from consideration here by including it among the diseases which are not allowed to travel. Cholera, moreover, is practically unknown in this country. The other diseases are, on the contrary, broadly distributed throughout the country and should be accepted for transportation under proper restrictions when the need for travel exists.

Sedgwick has epitomized typhoid prevention in the dictum that the problem is "to keep the excreta of A out of the mouth of B."[24] That is a very accurate statement; it practically covers the whole ground of preventive measures against typhoid, paratyphoid, and dysentery, which are transmitted by excreta and contracted by ingestion. The chief paths by which they spread from one person to another, and without doubt the paths responsible for practically all well-marked epidemics, are contaminated water, milk, and food But it must not be supposed that diseases contracted from alimentary excreta are never conveyed by contact. Quite the reverse is true; transference of the germs by soiled fingers is by no means a rare occurrence. The hands of the patient himself are inevitably contaminated, and the hands of his personal attendant are kept free from infection only by the most painstaking care. Extensive investigations[25] by the United States Public Health Service of typhoid fever in Washington resulted in the conclusion that about one-third of all the cases found there were the result of contact infection.

In safeguarding the transportation of persons afflicted with the fecal-borne diseases, the same measures in general should be applied as have been described for the sputum-borne diseases: There should be isolation from other passengers; a personal attendant; and provision for the disinfection of hands, utensils, and dangerous discharges. The dangerous discharges are in this case, however, the urine and feces, which contain the infectious agents by which the diseases are spread. In rare instances the sputum in typhoid fever may also be infectious, and if much sputum is raised it should be cared for and destroyed as has already been described; but as a rule there is little cough and no sputum, and there will be no call for this procedure. The essential point is the thorough disinfection of the alvine discharges and their disposal in such a way that they can not endanger other people through water, food, or manual contact.

The section of the Standard Railway Sanitary Code dealing with the fecal-borne diseases reads as follows:

SEC. 4. *Typhoid and dysentery.*—Common carriers shall not accept for transportation on any railway train, car, or other conveyance any person known by them to be afflicted with typhoid fever, paratyphoid fever, or dysentery, unless said person is placed in a compartment separate from other passengers, is accompanied by a properly qualified nurse or other attendant, and unless said nurse or attendant shall agree to comply and does so comply with the following regulations:

---

[24] Quoted from McNutt, A Manual for Health Officers, N. Y., 1915, p. 194.

[25] Hygienic Laboratory Bulletin No. 78, U. S. Govt. Printing Office, 1909.

(*a*) Communication with the compartment in which the patient is traveling shall be limited to the minimum consistent with the proper care and safety of the patient.

(*b*) All dishes and utensils used by the patient shall be placed in a 5 per cent solution of carbolic acid or other fluid of equivalent disinfecting value for at least one hour after they have been used and before being allowed to leave the compartment.

(*c*) All urine and feces of the patient shall be received into a 5 per cent solution of carbolic acid or other fluid of equivalent disinfecting value, placed in a covered vessel, thoroughly mixed, and allowed to stand for at least two hours after the last addition thereto before being emptied.

(*d*) A sheet of rubber or other impervious material shall be carried and shall be spread between the sheet and the mattress of any bed that may be used by the patient while in transit.

(*e*) Said nurse or attendant shall use all necessary precautions to prevent access of flies to the patient or his discharges, and after performing any service to the patient shall at once cleanse the hands by washing them in a 2 per cent solution of carbolic acid or other fluid of equivalent disinfecting value.

(*f*) *Provided*, That if a person with typhoid or dysentery is presented at a railway station in ignorance of these regulations, and his transportation is necessary as a life-saving or safeguarding measure, an emergency may be declared and the patient may be carried a reasonable distance in a baggage car if accompanied by an attendant responsible for his care and removal; *Provided also*, That regulations (*a*), (*b*), (*c*), (*d*), and (*e*) of this section shall be complied with in so far as the circumstances will allow, and that all bedding, clothing, rags, or cloths used by the patient shall be removed with him: *And provided further*, That any parts of the car which have become contaminated by any discharges of the patient shall be disinfected as soon as practicable, but not later than the end of the run, by washing with a 5 per cent solution of carbolic acid or other fluid of equivalent disinfecting value.

By official adoption of the Standard Railway Sanitary Code these regulations for the travel of typhoid, paratyphoid, and dysentery now apply in Alabama, Florida, Georgia, Illinois, Kentucky, Kansas, Louisiana, Maine, Maryland, Michigan, Minnesota, Mississippi, New Hampshire, North Dakota, South Carolina, Tennessee, Virginia, West Virginia, Washington, and Wisconsin, and by reason of the practical identity of the Interstate Quarantine Regulations they apply also to all travel from one State into another. The States of Oklahoma and Montana have practically the same regulations as to typhoid and paratyphoid, but they do not include dysentery.

Remembering that the diseases referred to are intestinal diseases, that they are transmitted by alvine discharges, and that there is frequent necessity for the use of the bedpan or urinal in their care, the reason for adding subsection (*d*) will be apparent; it is a reasonable precaution for protection of the bedding from possible contamination and is common practice in hospitals or private houses. The emergency provision of subsection (*f*) is to meet a condition which has been met in actual practice, in removing typhoid patients from branch line mining camps to hospitals for care, in which case the attempt to apply the letter of the regulations might lead to very great hardship and danger.

Departure and arrival permits, as provided in the Interstate Quarantine Regulations, are probably wise requirements in these diseases as in those that are sputum borne; they are practically a part of good communicable-disease reporting. As a matter of fact, many States forbid the removal of any case of a communicable disease to a new location, even within the same health jurisdiction, unless a permit has been obtained. The demand for a written agreement to comply with the regulations would seem to be an unnecessary refinement, which might tend toward the evasion of details. There must be evidence of compliance in fact. That will give the required protection, which the written agreement will not.

It would seem to be hardly necessary to present arguments for the inclusion of paratyphoid and dysentery along with typhoid fever in any travel regulation applying to the latter. From the standpoint of transmission, the diseases are so similar as to make them a natural group, and the measures of control are essentially the same for each.

In carrying out the measures prescribed for making the transportation of typhoid and its related diseases safe, most of what was said in connection with the sputum-borne diseases applies with equal force. There is the same necessity for isolation; for the care of a skilled attendant; and for the disinfection of bodily wastes, of the nurse's hands, and of eating and drinking utensils. The preceding sections should be consulted for details. Only those phases of the subject will be considered here in which there is some difference to be noted.

1. *Isolation.*—The need for isolation of typhoid-fever cases is not so great as for those that are sputum borne. There is no danger from mere proximity, since the danger of droplet infection is practically nonexistent. For this reason a cot in a baggage car is a tolerable condition for a journey of moderate length. There is really no valid hygienic objection to the patient occupying an ordinary sleeping-car berth if proper care and attention to prevent contact infection are provided. The danger to other passengers under such conditions would be negligible, and if the journey may begin and end during the same night it might be permitted with safety. But under the conditions in the open car it is more than a little difficult to give the necessary care to the alvine discharges; and during the daytime, when other passengers are up and about, the use of the bedpan and urinal would be intolerable. So isolation in a separate compartment is a practical necessity, apart from strictly hygienic demands. Indeed, it should be required for all bedridden patients, whether their diseases are communicable or not, except when their journeys may begin and end within the same night. A discussion of the details of isolation will be found under the section on the sputum-borne diseases.

2. *Care of excreta.*—The care of urine and feces is the essential feature of the control of intestinal infectious diseases, and is the chief point wherein the transportation of typhoid and dysentery differs from that of the sputum-borne group. These discharges should be received into vessels (bedpan or urinal) containing a small amount of disinfectant solution. They should then be emptied into another vessel, more disinfectant added, and the contents thoroughly mixed: or an excess of disinfectant solution may be added to the receiving vessel and disinfection finished therein. A quantity of disinfectant at least equal to the total amount of excreta should be added, and if there are any solid portions they should be disintegrated and entirely covered over with the solution. The vessel should be covered and the contents allowed to stand until disinfected. After two hours it may be safely disposed of in any way that normal feces are disposed of. After emptying, bedpans and urinals should be rinsed with the same solution. If it should happen that excreta are collected shortly before arrival at destination and can not be kept the required two hours after adding the disinfectant solution, the vessel may be left in the compartment toilet room for later disposal by the car-cleaning crew.

A 5 per cent solution of crude carbolic acid may be used for disinfecting urine and feces in the manner above described. Other solutions of equal disinfecting value which may be used are: Chlorinated lime, 3 per cent; compound cresol, 3 per cent; or formalin, 10 per cent. The last named has the advantage of entirely destroying any foul odor; it possesses, however, a pungent odor of its own, which may be somewhat irritating unless the vessel is closely covered.

If there is coughing with expectoration, the sputum should be cared for as described under the sputum-borne diseases; or it may be disinfected with the secretions from the bowel and bladder.

3. *Attendant's hands.*—It has been thoroughly established that the hands of those who nurse or otherwise handle typhoid-fever patients regularly become contaminated with typhoid bacilli. Scrupulous care is therefore necessary if the attendant is to safeguard himself properly against infection by ingestion of bacilli from soiled fingers. After handling the patient, and especially after handling the alvine discharges, the hands should be thoroughly cleansed with soap and water and then dipped in a disinfectant solution. This should be done at once, before other things may have become contaminated by being handled. The details differ in no way from those described in discussing the sputum-borne diseases and need not be repeated here; but the particular source of infectious material should be always borne in mind.

4. *Care of bedding.*—It is to be presumed that patients suffering from typhoid fever can not be transported for any considerable dis-

tance except in a separate compartment of an ordinary sleeping car, in which case all necessary bedding and linen will be furnished by the carrier. It is unnecessary to impress upon those even moderately well trained in the care of such cases that scrupulous cleanliness of the bed and bedding is always necessary. The frequent necessity for use of the bedpan and urinal makes it practically impossible to keep the sheets entirely free from infectious contamination. The use of a rubber sheet for the protection of the mattress is even more necessary in acute intestinal diseases than in that of other diseases. Some such arrangement is a part of the ordinary care of typhoid patients, wherever they may be; and it is properly one of the requirements in arranging for the transportation of typhoid patients that a rubber sheet must be provided and used in the way indicated, as part of the necessary precautions in making travel safe.

With reasonable care, blankets and pillows are not liable to gross contamination. They are, in regular sleeping-car practice, incased in clean linen, which may be changed as often as is necessary. In making up the berth the curtains should not be hung. Any necessary screening may be improvised from sheets. All used linen should be placed in a bag or tied into a bundle by the attendant and kept to the end of the journey; it is, of course, immediately laundered after being released. It is advisable also that blankets be similarly treated, and this is provided for in the regulations.[36]

Summary.—The measures described for the safe transportation of communicable diseases of the acute intestinal type are only the essentials of their safe care and proper isolation in any other place. The facilities and utensils required are those of the sick room. In arranging for the transportation of cases of this kind it should be made clear to the attendant just what it is necessary to provide. The articles are: (1) Disinfectants for making up solutions for the care of hands, of dishes, and of the patient's bodily wastes. (2) A receptacle for disinfecting dishes, unless paper dishes are used. (3) A basin for disinfecting the hands of the attendant. (4) A receptacle for urine and feces and for disinfecting them. (5) Rubber sheeting for protecting the bedding.

3. PULMONARY TUBERCULOSIS.

From the standpoint of railway travel, the only important form of tuberculosis is that which affects the lungs, not only because this is much the most frequent form of the disease, accounting for some 95 per cent of all the cases after childhood, but also because it is the only form from which there is likelihood of spreading tuberculosis infection. The sputum of patients with phthisis is the chief source of tubercle bacilli, and is practically the only medium through which the disease is spread from one person to another. In considering the danger to the public health that may arise through the transportation of tuberculous persons, our inquiry may therefore be limited to pulmonary tuberculosis and to the sputum as the source of infection.

---

[36] Sec. 10 of the Standard Code and of the Interstate Quarantine Regulations. See Appendix.

Extent of tuberculous travel.—We have no way of determining accurately the number of tuberculous persons among railway travelers. No census has ever been taken and no dependable one can be taken. Only the very ill can be identified by casual inspection even by expert observers, and the majority of patients will remain undetected unless they declare themselves. But we know that sufferers from pulmonary tuberculosis are great travelers. The reputed curative qualities of the climate of various regions lures them abroad in hope of regaining their health through climatic influences. One place failing, they go to another, and from that to another still; for there will always be some one to tell of the wonders that lie beyond, and the ill are credulous.

Our arid Southwest, southern California, the mountains of Colorado, and parts of the Carolinas bear the reputation of therapeutic El Dorados, and there has been a vast amount of travel to these regions by the tuberculous in search of health. From an extended inspection of trains in the Southwest, Sweet[27] concludes that the vast majority of cars passing through western Texas and New Mexico carry consumptives at some stage of their journey. He found that the greater number, about 50 per cent, ride in day coaches, while 30 per cent occupy tourist sleepers and 20 per cent are in standard Pullmans. Contrary to what might be expected, he found the local traffic heavier than the transcontinental trains in the number of cases carried, though the latter carried the larger number of invalids. Consumptives, like all other people more or less chronically ill, are as a rule dissatisfied with their surroundings, and many of them even after arrival in a favorable climate wander from place to place in search of better conditions. This, according to Sweet, together with the fact that much of the population of the Southwest is made up of the invalid class, accounts for the heavy local traffic.

In earlier days the resort regions advertised their climatic virtues extensively, until an exaggerated popular belief in their curative qualities was produced; and they welcomed the tuberculous immigrant. Both the advertising and the welcome have now largely disappeared, but without having had any very great restraining influence on the amount of tuberculous travel. Sweet believes that while the transportation of far advanced cases is growing somewhat less, travel in the earlier stages is increasing rather than otherwise. And he finds no reason to doubt the estimate of the National Tuberculosis Association that annually 10,000 consumptives who are hopelessly diseased go into the West to die.

---

[27] Sweet. Interstate Migration of Tuberculous Persons, Public Health Reports, Apr. 9, 16, and 23, 1915; Reprint No. 269.

In addition to train inspection, much information concerning the amount of tuberculous travel can be gained from a study of the death rates of communities, estimates of the tuberculous population of certain favored regions, and such hospital and other records as are available. A few years ago the United States Public Health Service made an extensive study of the interstate migration of tuberculous persons on such a basis. One of the investigations was reported by Sweet in the article above referred to, covering the States of Texas and New Mexico. Others were made by Foster,[28] in North and South Carolina; Carrington,[29] in California; and Lanza,[30] in Arizona and Colorado.

The report by Sweet is especially thorough. He found the annual death rate from tuberculosis to be much higher in the resort regions than in other parts of the country. For the 10-year period ending with 1912 it averaged 1,404.6 per 100,000 of population in Albuquerque, 788.7 in El Paso, and 449.2 in San Antonio, against 149.5 in the whole registration area of the United States. In tracing out the origin of the fatal cases, it was found that 91 per cent of those at Albuquerque, 63.4 per cent of those at El Paso, and 52.2 per cent of those at San Antonio were among interstate migrants; and a large proportion of those coming from other States had been in residence so short a time when they died as to leave no doubt that they had come in after the disease was well advanced.

Of the fatal cases in Albuquerque during 10 years, 15.6 per cent died within 30 days after arrival, 46.1 per cent within 6 months, and 57.8 per cent within 1 year. For El Paso the figures were 11.5 per cent within 30 days, 30.5 per cent within 6 months, and 38.8 per cent within a year; but if the cases among the Mexican population of El Paso are eliminated, the figures are practically the same as for Albuquerque, 18 per cent dying within 30 days and 46.7 per cent within 6 months after arrival. In San Antonio 32.7 per cent of the fatal cases had been in residence less than 6 months.

These figures indicate that the railroads are forced to carry many cases of advanced tuberculosis to the resort regions; but they by no means tell the whole story, because they do not include the many hopeless cases which return to their homes. The number actually remaining in the resorts when their condition is hopeless is relatively small. When hope is gone, they go back to their relatives and friends.

---

[28] Foster, Public Health Reports, March 12, 1915; Reprint No. 265.

[29] Carrington. ibid., March 19, 1915; Reprint No. 266.

[30] Lanza, ibid., June 18, 1915; Reprint No. 283.

The sanatoria almost invariably return to their homes the far advanced cases, in order to avoid the depressing influences of deaths in their midst, and this is also a general custom among practicing physicians. Furthermore, the various relief societies and State agencies find it cheaper, and also more satisfactory to the patient, to make similar disposition of the indigent cases, since they invariably require much care in the later stages of the disease. All this serves to increase the number of far-advanced cases transported, and incidentally to decrease the local tuberculosis death rate.

From the data obtained in his survey, Sweet concludes that not less than 10 per cent of the residents of the arid regions of the Southwest are tuberculous, or have some member of the family who is so afflicted. In some small towns in western Texas the proportion is said to be as high as 50 per cent, and in most of the towns of New Mexico 20 per cent or more. Most of these cases have come from other localities, for he considers it to be a fact that phthisis develops relatively infrequently among the resident population.

An intensive study in a Texas community of 16,000 recently made by Breed[31] revealed 193 cases of tuberculosis, 172 of which had come from other places because of their disease, and 100 of which had been in residence less than a year. A third of all the cases had been "wandering about" for their health.

Investigations in the Carolinas, California, and Colorado and Arizona gave results similar in kind to those reported for Texas and New Mexico by Sweet, though differing considerably in degree. For all regions the figures, while affording no basis for an accurate determination of the amount of tuberculous travel, indicate that it must be very large to all resort regions. That there must be much of it also in other parts of the country is apparent when we remember the great prevalence of pulmonary tuberculosis, its slow and chronic course, and that a large proportion of its victims go about their ordinary affairs for months or even years after they have become diseased. Of these last, there are many thousands who daily mingle with the public everywhere.

It will be clear from the above that a large number of consumptives are carried on the railways. In what way and to what degree are they a danger to the traveling public? And does the danger cease when the consumptive disembarks, or is it possible that the car he has occupied may become a source of danger to future occupants? Even with all the available facts in hand, no direct and positive answer to these questions is possible, because our knowledge of tuberculosis is not yet complete. But many facts have been brought out in recent years which tend to clear the situation and enable us to approximate the truth. That the danger is less than writers of even a decade ago commonly asserted, I believe is true; that it is something can not be denied. A brief review of our present conceptions of the epidemiology of tuberculosis is necessary for a proper consideration of the questions.

---

[31] Breed, A Study of the Indigent Migratory Consumptive Problem, Am. Rev. of Tuberc., 1921, iv, 866.

Modes of tuberculous infection.—In order that we may know the dangers of tuberculous infection and be able to apply the measures necessary to prevent it, the way in which tubercle bacilli enter the body must be definitely known. The question of methods of infection is therefore of paramount interest.

The three obvious portals for the entrance of tubercle bacilli are the respiratory tract, the digestive tract, and the skin or mucous membranes; by inhalation, by ingestion, and by inoculation, respectively. Each of these modes of infection is possible, and has been proved to be so both experimentally and clinically. From the fact that the disease is usually located in the lungs inhalation has been considered by many authors to be the most important of the three, but the indications of modern investigation are that ingestion will be found to be of very much greater importance. Infection by inoculation is rare.

It is conceivable that infection by inhalation may be brought about by inhaling dust from dried and pulverized sputum, or by inhaling droplets of mouth spray in the immediate neighborhood of coughing consumptives. Both ways are believed to be possible, but their relative or absolute importance in bringing about infection under natural conditions is not certain. Sputum, by reason of its content of mucus, is not readily pulverized. The making of dust from moist sputum is a prolonged process even under the most favorable conditions, requiring an interval and an environment which are more than likely to destroy or to render innocuous any bacilli which it contains. Tubercle bacilli, especially if exposed to light—and light is almost necessary for thorough drying—do not well survive the pulverizing process. Direct sunlight kills them quickly, and even diffuse light kills them in a few hours or days. ''It is exceedingly rare,'' says Fishberg,[33] ''to find a house where proper precautions are taken as to expectoration in which the collected dust shows virulent tubercle bacilli. Even in houses inhabited or frequented by consumptives—sanitariums, dispensaries, railroad stations, cars, etc.—no dust containing virulent tubercle bacilli has been found in most cases investigated. * * * Dust collected in the streets hardly ever shows the presence of living tubercle bacilli.''

It is doubtful, furthermore, if dust from dried sputum is often raised to such a height in houses as to reach the ordinary breathing zone of adult inhabitants. During vigorous sweeping it may be, but otherwise it is not likely. Under natural conditions the dosage of tubercle bacilli which might be acquired from such a source would ordinarily be small, and it has been shown that small numbers of bacilli can be readily disposed of by the human organism. The experimental evidence on which the dust-infection theory rests has, on the contrary, usually dealt with very heavy artificial dosage; or when it has been otherwise the results have been mostly negative. When all the facts are considered, the dust-infection theory, in its attempt to account for most, or even many, tuberculous infections under natural conditions, rests on an insecure foundation. It must be kept in mind, however, that certain kinds of dust, particularly the sharp particles derived from stone and metal, injure the lungs in such manner as to predispose to the development of pulmonary infections. Excessive dustiness is therefore to be avoided, regardless of whether the dust may be contaminated with tuberculous sputum.

---

[33] Fishberg, Pulmonary Tuberculosis, 1919, p. 42.

Careful research has proved that the air exhaled by consumptives during quiet breathing is free from tubercle bacilli, but the fine moist droplets of saliva and mucus emitted from the mouth while talking, coughing, or sneezing do often contain bacilli. Fluegge and his followers believe that the inhalation of these droplets accounts for the majority of tuberculous infections; other observers, and especially those whose work is more recent, do not. Most investigators have found that when a person is at a distance of 3 or 4 feet from the coughing patient droplets do not reach far enough to become a possible infective agent, excepting perhaps when carried by strong air currents. The bacilli thus eliminated soon sink to the floor, and thereafter become innocuous. Another important factor is that the dose of bacilli which may be thus inhaled is very small, probably not often exceeding the limit of tolerance. There are also many natural barriers against bacilli, either moist or dry, being carried into the lungs by inhalation. The nasal passages, mouth, and throat act as efficient filters, detaining inhaled droplets or dust on their moist surfaces. The mucous and lymph covered walls of the trachea and bronchi also retain impinging particles; and the ciliated epithelium of the bronchial tree maintain a constant outward flow of the surface mucus with all particles that have been caught. So bacilli can not enter the lungs with ease. From animal experiments, Bacmeister[33] found that they only rarely do so, and that the inhalation theory of infection in tuberculosis is very poorly supported. It must be borne in mind, however, that very fine particles of one kind and another may and do enter the lungs with the inspired air, as is evident from the common finding of carbon pigment in the lungs of city dwellers, and it is possible that tubercle bacilli may be thus sometimes brought there. But whether they are likely to cause local infection is a disputed question, with the weight of evidence apparently against it at the present time.

---

[33] Bacmeister, quoted by Fishberg, l. c., p. 46.

It seems much more probable, from the evidence we now have, that infection of the lungs with tubercle bacilli is usually by way of the blood stream and lymphatics, and that the common portal of entrance into the body is by way of the mouth and alimentary canal. The vast opportunity for hand-to-mouth infection from raw sputum, which is so carelessly and promiscuously spread about by coughing consumptives, will be readily realized. This is looked upon by Krause [34] as probably the most important mode of obtaining tubercle bacilli. The fact that so many children become infected soon after they begin to play about on the floors or in the streets is a significant fact in support of this view. There is also opportunity for ingesting tubercle bacilli with contaminated food and drink, and especially from eating and drinking utensils which have been used by the tuberculous and have been inefficiently cleansed. Cummings [35] considers the last the major mode of infection. He has done much experimental work with dishes and dish washing, the results of which lend some measure of support to his contention.

The evidence that ingestion, as opposed to inhalation, is the chief mode of tuberculous infection under the normal conditions of living becomes each year more convincing and more generally accepted. Even from dust and moist droplets, infection may be brought about by way of the digestive tract; for what lodges in the mouth is soon swallowed with the saliva, and what lodges in the trachea and larger bronchi is swept back into the throat to be swallowed later; or the bacilli may find entrance to the tissues directly from the throat through the tonsilar crypts and mucosa.

But whatever may be the route by which tubercle bacilli enter the body, there is no dispute of the fact that the sputum of tuberculous people is by all odds their most important and frequent source. Effective preventive measures will therefore require the proper disposal of sputum; and this should be done on the assumption that any or all of the methods of infection proposed may suffice under certain conditions. While it now appears that the greatest danger comes from contact with raw sputum, by manual transfer to the mouth, other things should not be neglected. Sputum must not be sprayed as droplets into the faces of people, deposited on the floor where it may become converted into dust or picked up on children's fingers, allowed to contaminate eating utensils and food, nor spread about in any place where it may become a source of infection through the various forms of contact; for so long as it is indiscriminately spread about, the multitudinous opportunities for infection will remain and the multitude of infections will take place.

---

[34] Krause, Essays on Tuberculosis, Journal of the Outdoor Life, 1919, XVI, 106.

[35] Cummings, Jour. Am. Med. Assoc., 1920, 74, 1072.

Extent of tuberculous infection.—The excessive prevalence of tuberculous disease is a fact of common knowledge; the vastly greater prevalence of infection with tubercle bacilli, without the development of disease, is not so commonly known. Investigation has shown that from 80 to 90 per cent of adult human beings who come to autopsy have visible evidence of tuberculous infection somewhere in their bodies, whatever the cause from which they died, and even a larger proportion of the living give the specific skin reaction which indicates such infection, though relatively few of either class show any evidence of the disease in active form. Only in the small minority of those who are infected does the presence of tubercle bacilli in the tissues bring about the changes or cause the symptoms that we know as the disease tuberculosis. The great majority go through life infected, but so far as they know or as can be ascertained they remain entirely healthy and well.

During the first two years of life the vast majority of children are free from tuberculous infection. But as they grow older and begin to run about and increase their opportunities for contact, the proportion found to be infected increases rapidly, so that at the age of 6 about 50 per cent, and at puberty about 75 per cent, are found to be infected. From that time on the proportion slowly increases, until by the third decade infection is practically universal.[36] On the basis of such figures, and they are fully substantiated by numerous investigations, it must be concluded that the tubercle bacillus is very widely distributed and that no one can wholly escape it.

Genesis of tuberculous disease.—It is clear that the presence of tubercle bacilli in the body does not necessarily call forth any active tuberculosis. In spite of our nearly universal infection, the most highly tuberculized community, except in certain regions frequented as health resorts, does not show more than 2 or 3 per cent of active cases at any one time, and but little more than 10 per cent will ever become manifestly ill of tuberculous disease. Just why the few succumb while the majority escape we do not fully know. But to all infections we have some degree of resistance which must be overcome before they produce disease, and in the case of tuberculosis most people have acquired, or in some way they possess, enough resistance to protect them.

That infection with tubercle bacilli is the prerequisite of tuberculosis is beyond a shadow of doubt, but something more than infection alone is needed to bring about active tuberculous disease; resistance must be overcome by the invading parasite. Among a possible multitude of conditions that may determine the overcoming of resistance, and infection becoming disease, two things stand out prominently—large dosage of tubercle bacilli and repetition of the infection. It has been clearly shown that a few bacilli may be successfully taken care of; but massive infection, and small doses repeated frequently enough to amount to that, can not. Of first importance, then, in the campaign against tuberculosis, is the protection of healthy subjects against massive or frequent infection.

---

[36] Figures from Krause, Essays on Tuberculosis, Journal of the Outdoor Life, 1918, XV, 163.

It is now fully recognized that the younger the individual the more likely is he to develop acute disease from any given tuberculous infection. Very young children have very little resistance, and succumb most readily when they become infected. One exposure, or a small dose of tubercle bacilli, may be very dangerous to a small child, whereas the same exposure or dosage may be harmless to an adult. The adult has, in the vast majority of instances, already been infected, probably not once but many times, and he bears the evidence of it in his body. It is more than probable that in the very process of overcoming these past infections he has developed the immunity that now in a large degree protects him. There is no doubt whatever that some change takes place in the body as the result of infection with tubercle bacilli which renders its reaction to further infection different from the reaction observed in the infection of virgin soil, something which renders the individual more resistant. The young child is virgin soil. As time goes on its tissues will inevitably become the seeding ground for tubercle bacilli. The longer the sowing is delayed the better is the chance of its failing to produce disease at once, and the smaller the early dosage of infection the greater is the probability of the child's developing the immunity that will protect his later life.

Many excellent observers now believe that tuberculosis makes only a single invasion in the pathologic sense. This original tuberculous infection may lead to acute and generalized disease, as it often does in the very young; but in the majority of instances the growth of the bacilli is limited by the development of immunizing substances in the tissues so that they cause only a local lesion, which then lies dormant and protects against reinfection from without. Whether illness will ever develop from the original tuberculous lesion depends on the mass of the original infection and on the various factors of hygiene and intercurrent disease that tend to break down the resistance of the tissues; for all immunity is relative, not absolute.

In such a conception the chronic tuberculosis we see in the period after childhood is only a lighting up and extending of an old and dormant process; it is the growth of an old infection rather than the acquiring of a new one. There is much to support this view. The statistics of hospitals and sanatoria for the tuberculous show that the prevalence of phthisis among the attendants is no greater than in other divisions of the civil population; and these statistics hold good, according to Fishberg,[37] through a period long preceding the modern practice in such institutions of that painstaking care of the sputum which tends to limit the possibility or the massiveness of infection. It has also been observed that the mild case entering such an institution is in no danger of superinfection from the more active cases with which he comes in contact. The course of his disease is in no way affected by such contact. In young children the disease is usually acute, but when adults of primitive peoples among whom tuberculosis has not before existed are first infected from foreign sources, they react as children do and die of acute disease; they have not the acquired immunity which is developed as the result of early and minute doses of tubercle bacilli.

Dangers of tuberculous travel.—The time relation between tuberculous infection and tuberculous disease is so indefinite that in epidemiologic studies we can only generalize, weighing the possible chances of recent infection against those that are more remote. It is rarely possible to know the origin of any case exactly. This makes it difficult to determine the effect on the public health of the travel of phthisical patients. There is little direct evidence in hand, and not a great deal that is obtainable. Interpretation of the danger must therefore be based largely on our general knowledge of the modes of tuberculous infection and the genesis of tuberculous disease which has been given in outline above.

There are two possible sources of tuberculous infection in railway cars—the patient himself and the car or its furnishings after the patient has left it. From the patient himself the possibility lies in droplets of mouth spray and in the various forms of direct and indirect contact with his sputum; from the car the possibility lies in dried sputum deposits or dust.

It has already been stated, on the authority of Fishberg, that it is rare to find virulent tubercle bacilli in houses frequented by the tuberculous if proper precautions are taken as to expectoration, and that none had been found in public places, such as railway cars and stations, in most investigations. It can scarcely be alleged, however, that railway passengers are a very careful lot. It is not surprising if they sometimes leave behind them sputum containing bacilli, which as a matter of fact they do. Thus Prausnitz[38] and Petri[39] were sometimes able to demonstrate tubercle bacilli on the floors of cars carrying many consumptives to the health resorts of Switzerland and to Berlin during the early activity of the Koch tuberculin treatment, when tuberculous travel was heavy and promiscuous spitting was common.

---

[37] Fishberg, Pulmonary Tuberculosis, 1919, p. 122.

[38] Muench. Med. Woch., 1892.

[39] Arb. a. d. kais. Gesundheitsamt, 1894.

Somewhat later, in this country, Kinyoun[40] made an extended investigation of the bacteria to be found in railway cars; and he also found tubercle bacilli, but only very rarely. He collected the dust from the floors, carpets, and upholstery, and from the air of cars, and subjected it to microscopic examination, bacteriological culture, and animal inoculation.

He similarly tested the material gained by rubbing with moist swabs the interiors of cars. In the many samples which were examined microscopically two were found containing an organism resembling the tubercle bacillus, but identification could not be made complete nor the question of virulence solved. Of 196 guinea pigs which were inoculated intraperitoneally with the dust and other materials, only one developed a positive tuberculosis. When the extreme susceptibility of these animals to very small doses of tubercle bacilli is considered, and that many of the cars examined were running to health resorts in the Southwest and carried many consumptives, the surprising fact is not that tubercle bacilli were found by this very delicate test, but that so few were found.

If the results obtained by Kinyoun may be taken as typical, even though dust were a more potent source of tuberculous infection than is now commonly supposed, it would seem that the chances for infection from this source under the normal conditions of travel must be exceedingly small. There is no natural method of infection which approaches in delicacy and certainty the injection of organisms into the peritoneum, and even to that delicate test for the presence of tubercle bacilli the human being would be many times more resistant than is the guinea pig. The inference seems to be warranted either that few tubercle bacilli are deposited in cars or that the most of them soon die. The number deposited depends, of course, on the habits of those who travel, and the continued crusade against spitting has probably determined that fewer are deposited now than were in former times, but the habits of travelers are not yet as good as is desirable. Good car cleaning would, of course, tend to limit the number found at any time; but the fact that cars have many windows and are freely flooded with sunlight, known to be destructive to the life or virulence of tubercle bacilli, is probably of the greatest importance in determining the meager findings that have been made.

The facts as outlined seem to indicate that the danger of acquiring tuberculous infection from the previously infected car must be very small, and the tuberculous fellow traveler becomes the matter of most importance from the standpoint of public health. It is highly probable that tuberculous infection is contracted, under natural conditions, chiefly from contact with the freshly voided sputum of those persons who have phthisis. It must be remembered, however, that tuberculosis is an ubiquitous disease. Simple proximity to it is unavoidable. Whenever we go into public places we are liable to come in contact with those who have it. Such danger as that involves is present everywhere. In this regard the railway car differs but little from the theater, moving-picture hall, department store, street car, school, office, and other similar places; all are liable to have in them active cases of phthisis. And active cases of phthisis are the source of tuberculous infection.

---

[40] Kinyoun, The Bacterial Content of the Railway Coach, Med. News, July 29, 1905.

It is generally assumed that the danger of tuberculous infection is proportional to the severity of the patient's illness. In general this may be true, but it is not necessarily so. The advanced case may be, and often is, a safer companion than the early case; for many of those who are only slightly sick produce large numbers of tubercle bacilli, and some of those whose disease is far advanced produce relatively few bacilli. It is probable also that the advanced cases have had more and better training in the protection of their surroundings and of those about them. The car is perhaps more likely to have in it actual invalids than are other public places; but these will at most make up only a small proportion of the total cases met with and need not add materially to the danger, which depends far more on the habits of the patient than on the stage of his disease.

So far as the danger of infecting adults is concerned, the vast majority of them have already been infected with tubercle bacilli and have acquired the relative immunity to further infection from without which is conferred by overcoming an infection in early life. Lowered resistance and breakdown, not an immediately preceding infection, sets the date for the onset of phthisis in such persons. But acquired immunity to infectious diseases is rarely absolute; it is only relative—sufficient for the ordinary conditions of life, and failing in emergencies, of which massive infection should perhaps be considered one. The question arises in the case of tuberculosis, Does association in railway cars afford opportunity for the massive infection that might constitute such an emergency? It appears that it does not; for experience has taught us that both prolonged and intimate contact is necessary for such a result, and in ordinary railway journeys neither condition prevails.

It is conceivable that the conditions surrounding railway travel might contribute to the lowering of personal resistance in such a degree as to determine the lighting up of old tuberculous foci. The riding of railway trains can scarcely be called a stimulating occupation; there is involved in it very often a certain amount of irregularity and hardship. Habits of eating, of exercise, of rest, and of sleep may be thrown out of their normal relations; there may be exposure to dust, or to inadequate ventilation and heat; and if journeys are long there may be considerable fatigue for those unaccustomed to travel. But such influences must be much more prolonged and much more marked than they are under the ordinary conditions of travel if they are to attain to much importance in bringing about such a result.

If railway coaches and sleeping cars were a potent source of tuberculous infection or had any perceptible influence in causing the development of tuberculous disease, we should expect this fact to appear in its influence on the health of those employees who are obliged to spend a large portion of their lives in these cars—we should expect to find a high tuberculosis rate among passenger-train conductors, passenger brakemen, and sleeping-car conductors and porters. Unfortunately there are very few exact data on this point. There is, however, among railway surgeons of large experience, a common belief that the case is otherwise—that passenger-train men suffer rather less from tuberculosis than do other classes of employees. Railways have rarely kept statistics in such detail as will verify the correctness of this view, but we have in figures from the Pennsylvania Railroad relief fund, published by Dudley[41] in 1905, some evidence that supports it. The statistics showed that tuberculosis was more prevalent among freight-train conductors and brakemen belonging to the fund during the 18 years of its life than among the corresponding employees on passenger trains, the average yearly disablement rates from tuberculosis being as follow:

	Per 100,000 per annum.
Disablement rate for passenger conductors	330
Disablement rate for passenger brakemen	120
Disablement rate for freight conductors	400
Disablement rate for freight brakemen	170

The conductors represented in the above groups were mostly older employees who had been taken into the fund without examination, while the brakemen were younger employees who had been examined and pronounced sound before admission. This is supposed to explain the lower disability rate among the brakemen of each class than among the corresponding conductors. It will be noted, however, that both conductors and brakemen on freight trains suffered more disability from tuberculosis than the corresponding groups on passenger trains.

The statistics of deaths from tuberculosis were considered reliable only during the last four years of the period covered by the above figures, during which all cases of illness were carefully followed even after leaving the company's service. The death rates from tuberculosis were as follow:

---

[41] Dudley, The Dissemination of Tuberculosis as Affected by Railroad Travel, The Medical News, December 16, 1905.

	Per 100,000 per annum.
Death rate for all members of the fund	90
Death rate for passenger conductors	77
Death rate for passenger brakemen	52
Death rate for freight conductors	100
Death rate for freight brakemen	67

Here again, as in the previous case, the danger of tuberculosis as measured by the death rate in these groups is less for passenger-train men than for freight-train men, and in the case of the passenger-train men both conductors and brakemen show a lower death rate than the average for the whole membership of the fund.

Nor does it appear that railway employees in general suffer more from tuberculosis than do those engaged in other occupations. Indeed, it seems that they suffer rather less than the average. Heminway[42] says, "it appears that those who travel are less likely to consumption than those who stay at home," a statement which he supports in part by the following table compiled from the United States Mortality Statistics for the decade ending 1909, showing the relation of deaths from consumption to the total number of deaths in certain occupation groups:

	Total deaths.	Consumption.	Consumption.		Total deaths.	Consumption.	Consumption.
			Per cent.				*Per cent.*
All occupations	204,975	29,821	14.5	Boatmen	1,706	179	10.5
Steam railroad employees	5,368	386	7.2	Salesmen	2,513	398	15.8
Physicians	1,421	94	6.6	Food manufacturers	3,140	505	16.0
Lawyers	1,325	99	7.5	Street car employees	686	128	18.6
Commercial travelers	540	54	10.0	Bookkeepers	1,702	372	21.8
				Clerks	6,772	1,908	28.2

Regulation of tuberculous travel.—In cars, as everywhere else, young children are most in danger of acquiring tuberculous infection. Not only are they more highly susceptible than older people, and unprotected by the partial immunity derived from overcoming an earlier infection, but they have not acquired those habits of personal cleanliness that come with later years and that are such potent factors in the self-protection against all infectious diseases. Their universal tendency to establish relations with their new world through the sense of taste renders them especially liable to that commonest of all modes of infection—directly from hand to mouth. In every public place they should be kept from playing on floors, where sputum contamination is most likely to be found and where cuspidors may be in all too easy reach of their exploring fingers.

---

[42] Heminway, The Transportaion of Consumptives, The Railway Surgical Journal, 1915, XXI, 35.

As we now understand the problem, the limitation of tuberculous disease depends in large measure on the protection of early childhood against infection. While children represent only a small proportion of travelers, from the standpoint of the hygiene of travel they are the most important part and require the most careful protection.

But while the protection of children against infection is more important than that of adults, the interests of the adult, though he is relatively invulnerable, must not be lost sight of or neglected. All measures must be general. Calmette [43] has said, "the guiding principle in the social campaign against tuberculosis is the protection of healthy subjects, whether infant or adult, against massive or frequent infection. This fundamental idea should be made known among the people by every possible means." And because both of the real protection involved and of its educational value, tuberculous travel should be surrounded by restrictions.

In recent years many States have forbidden tuberculous persons to engage in certain occupations, particularly those having to do with the preparation of food and with the care of children, but few have dealt in any way with restriction of their movement, and those few have scarcely gone further than to provide for the moderate restraint of such patients as show themselves more than ordinarily negligent of the simplest rules of hygiene and who persist in their refusal to follow advice. With a single possible exception,[44] none of the States, by either law or regulation has forbidden them to travel, though a few, following the example of the Interstate Quarantine Regulations of 1916, and more recently by adopting the Standard Railway Sanitary Code, have laid down certain conditions with which they must comply when travel is undertaken. The care of the sputum has properly been the point of attack where regulations have been made. The section of the Standard Railway Sanitary Code covering the matter reads as follows:

> SEC. 9. *Pulmonary tuberculosis.*—Common carriers shall not accept for transportation any person known by them to be afflicted with pulmonary tuberculosis in a communicable stage unless said person is provided with (*a*) a sputum cup made of impervious material and so constructed as to admit of being tightly closed when not in use, (*b*) a sufficient supply of gauze, paper, or similar articles of the proper size to cover the mouth and nose while coughing or sneezing, (*c*) a heavy paper bag or other tight container for receiving the soiled gauze, paper, or similar articles; and unless such person shall obligate himself to use the articles provided for in the manner intended, and to destroy said articles by burning or to disinfect them by immersing for at least one hour in a 5 per cent solution of carbolic acid or other solution of equivalent disinfecting value; nor shall any person knowing himself to be so afflicted apply for, procure, or accept transportation unless he shall have agreed to and made all necessary arrangements for complying and does so comply with the regulations as set forth in this section.

---

[43] Calmette, International Journal of Public Health, July, 1920, I, 3.

[44] New Jersey.

Such are the regulations in the States of Alabama, Florida, Georgia, Illinois, Kansas, Kentucky, Louisana, Maine, Maryland, Michigan, Minnesota, Mississippi, New Hampshire, North Dakota, South Carolina, Tennessee, Virginia, West Virginia, Washington, and Wisconsin. The regulations in Oklahoma and Montana, and for all travel from one State into another under the Interstate Quarantine Regulations, are the practical equivalent of the above. It will be noted that under these regulations the responsibility for preventing tuberculous travel lies largely with the individual who has the disease. This provision is a necessary one; for without an obligation being placed on the patient to refrain from traveling or to make his condition known, the railroads have practically no power to make the regulations effective. They can not know the tuberculous individual; the patient should be enjoined to provide the things required of him out of his own initiative and out of his own knowledge of his condition. In the absence of such an obligation, no plan can accomplish much.

Perhaps in the case of phthisis no plan can accomplish very much anyway; but the very greatness of the tuberculosis problem makes every point of attack an important one and every possible means of limiting the chances of massive infection, more especially the infection of children, worthy of such effort as can be accorded to it. The injunction to the tuberculosis patient in traveling is the injunction to the tuberculosis patient everywhere. On the patient rests the responsibility of being careful of his sputum, of avoiding such distribution of it as will render others liable to infection. When he rides in public vehicles his responsibility does not cease, but rather increases, and every means should be taken to bring this fact home to him.

It is scarcely necessary to expand upon the details of carrying out the provisions of the regulations quoted. With the exception of the sputum cup they are simple: Sputum must not be distributed; what is contaminated with sputum must be put away and destroyed.

Concerning the sputum cup, I am not sanguine. I have rarely seen them used outside of institutions. They are too conspicuous to appeal to the average individual as a desirable companion. The destructible paper one is practically hopeless in car service; there is no place to put it when not in use; it soon becomes foul and may readily defeat its own purpose; it is scarcely better than the ordinary cuspidor, which indeed may be used practically without danger to anyone provided it is used carefully and sputum is actually deposited within it. But the metal pocket flask, if properly made, is neither unsightly nor troublesome, is conveniently used and easily put away, and the tuberculous patient who understands and has a sanitary conscience will surely provide himself with one.

4. LEPROSY.

Leprosy is one of the oldest known diseases. It was much more prevalent in ancient times and down through the Middle Ages than it is now, but it still prevails widely in certain parts of the world, such as India, China, Japan, and South Africa. There are many cases in the Philippine and Hawaiian Islands. On this continent the disease is relatively rare, but it exists in the Gulf States, among the orientals on the Pacific coast, and considerably in Mexico.

Leprosy is presumably transmitted by the discharges from the sores which form the open lesions of the disease. These may be located on the surface or in the mucous membranes. The mouth, nose, and throat are favorite locations, but the conjunctiva and the intestinal mucosa may be involved. The sputum and nasal secretions often contain the lepra bacilli in large numbers.

Leprosy was looked upon as contagious in very ancient times. It is now known, however, that the disease is not so easily transmitted as it was thought to be in the past. While we do not know all the conditions necessary, it is evident that the closest and most intimate contact is essential and that the degree of contagiousness is very small indeed. Casual contact is of no significance. The doctors, nurses, and Sisters of Charity who care for leprous patients are very rarely attacked. Rosenau[45] says "there is no more danger from a leprosy patient with clean personal habits, who exercises care concerning the discharges from the lesions, than there is from an open case of tuberculosis of the glands of the neck." The latter is not looked upon with fear, and neither is leprosy in those countries where it is more prevalent and better known; but the fear of leprosy is almost universal in this country, and is a matter to be reckoned with in considering the transportation of leprous patients, for people generally are thrown into a panic by knowledge of the simple proximity of such persons. This attitude probably arises from common knowledge of the cry "unclean" with which leprous persons were obliged in ancient times to warn the public of their presence, and is fostered by sensational newspaper accounts of those cases that become known. Logic plays no part in the reaction, which is founded on ignorance and misconception. But if the fear of contracting leprosy is not well founded, the dread of having it certainly is, because of its mutilating and usually fatal character.

Fortunately we have relatively few lepers in this country, and most of those are under restraint; for in most communities recognized cases are not tolerated at large. There is therefore little chance for lepers to travel on the railways except under the direction of a public health official. Their transportation is nevertheless sometimes necessary. The very fact that the number of cases is small enables us to isolate or deport all cases that are known, and thus to guard against the slow spread of the disease that might take place if the patients were left at large. When a case of leprosy is discovered in a community it should be removed to a Government institution, such as is maintained at Carville, La., for permanent isolation and care, or, if the patient is a foreigner, to a seaport for deportation. In either instance long railway journeys are usually involved in their transfer.

---

[45] Rosenau, Preventive Medicine and Hygiene, N. Y., 1916, p. 329.

Leprosy was the first disease for the transportation of which specific regulations were made. The Interstate Quarantine Regulations have contained rules for the safe transport of lepers since 1912. Through various revisions the regulations have come into the following form:

> SEC. 5. *Travel of lepers.*—Common carriers shall not accept for transportation or transport in interstate traffic any person known by them to be afflicted with leprosy, nor shall any person so afflicted accept such transportation except as hereinafter provided.
>
> (*a*) A person afflicted with leprosy shall be permitted to accept transportation upon presentation of permits from the Surgeon General of the United States Public Health Service, or his accredited representative, and from the health authorities of the States, Territories, or District of Columbia to and from which he intends to travel, stating that such person may be received under such restrictions, which shall be specified in each instance, as will prevent the spread of the disease, provided such person shall have agreed in writing to comply, and does so comply, with the restrictions as specified.
>
> (*b*) Any person who presents symptoms of leprosy and who is traveling or who has left the State where he resides in violation of the above regulations shall be detained and, if proved to be a leper, shall be returned to such State or removed to such Federal station as the Secretary of the Treasury may designate, and the proper health authorities notified.

The Standard Railway Sanitary Code has practically the same restrictions. The section pertaining to the transportation of leprosy reads as follows:

> SEC. 8. *Leprosy.*—Common carriers shall not accept for transportation nor transport in any railway train, car, or other conveyance any person known by them to be afflicted with leprosy, unless such person presents permits from the Surgeon General of the United States Public Health Service or his accredited representative, and from the State department of health of the States from which and to which he is traveling, stating that such person may be received under such restrictions as will prevent the spread of the disease, and said restrictions shall be specified in each instance; and no person knowing or suspecting himself to be afflicted with leprosy, nor any person acting for him, shall apply for, procure, or accept transportation from any common carrier unless such permits have been received and are presented, and unless the person so afflicted agrees to comply and does so comply with the restrictions ordered.

By both of these regulations the transportation of cases of leprosy is brought under the direct supervision of the United States Public Health Service and the health authorities of the States of origin and destination, which jointly make rules for each case according to conditions.

The specifications invariably provide that the patients shall be accompanied by a representative of the health department arranging for the transport, that they shall be strictly isolated and under guard, shall have their own eating and drinking utensils, that all discharges shall be disinfected and properly disposed of, and that the space they occupy shall be disinfected after the patients disembark. Such patients are virtually prisoners of the State, and the accompanying officer is responsible for their safe delivery at destination as well as for carrying out all of the sanitary arrangements that may be ordered for the individual case.

Isolation during the transportation of lepers may be carried out in the private room or compartment of any car with perfect safety, though objection is often raised to assigning space for the purpose. The attendant may, as he sometimes does, occupy the room with the patient. When several patients can be taken at once, the better plan, and the one usually followed, is to engage a tourist car or coach to run as a private car for the purpose. In either event, as the matter is actually handled in practice by public health departments, the public is not exposed to any danger.

5. VENEREAL DISEASES.

The common venereal diseases are syphilis, gonorrhea, and chancroid. They are infectious and communicable. Their causative organisms and modes of transfer are well known; they are therefore preventable. By appropriate treatment they are generally curable; but if not treated, syphilis and gonorrhea become chronic and may be indefinitely prolonged.

The venereal diseases are so prevalent as to constitute one of the greatest of modern plagues. No other group of diseases is responsible for so much suffering and continued inefficiency. Their effects extend from the individual to the family, the community, and posterity. They exert a considerable, though unknown, effect on the general death rate.

This would seem to be a combination of qualities well fitted to the health officer's hand: prevalent, and disastrous to the public health; communicable, with the paths of transfer known; preventable and curable. But so vast is the social evil out of which the venereal diseases come, so deeply is this problem rooted in human life, and so closely is it interwoven with kindred social problems yet unsolved, that the difficulties to be overcome are greater than in any other disease. In spite of the large public health problem which these diseases bring about, no serious attempt to control them was made until very recent years. And no progress in their control was made until a few health officers of larger vision determined to ignore the social and moral aspects of the case and treat these diseases as any other communicable and preventable infection, to remove the veil of secrecy by which they were surrounded and to make them subject to report and quarantine.

This change in attitude is practically limited to the last decade. Previous to that time the venereal diseases were looked upon as entirely private affairs, as just punishments for sins committed; they were not reportable to public health authorities or subject to control in any way. With our entrance into the European war, in 1917, the necessity of protecting the military forces against infection brought this whole question into prominence and gave great impetus to the matter of control. On the simple basis of public health protection, ignoring the social and moral questions involved, laws and regulations were enacted making the venereal diseases conditionally reportable and subject to quarantine in practically all of the States. At the same time an extensive educational campaign was inaugurated and has since been carried on.

It has not yet been determined what good has been accomplished by these regulatory measures, the administrative details of which are still in the experimental stage. Reporting is very imperfectly carried out, and the great majority of the victims of venereal disease still hold their afflictions secret and personal. But the effort to educate the people concerning the nature and significance of the venereal diseases, the suppression of persistent offenders against the sanitary laws, and the opening of many dispensaries for the free treatment of patients can not have been quite useless. Many thousands of cases have been treated in the free clinics established by the States, and a large proportion of them have been cured completely or rendered noninfectious, which would have remained infectious under the inadequate care so often provided by personal initiative. Each case so remedied removes one source from which the diseases are spread. Such treatment is one of the most importent elements of venereal disease control.

In drawing up the Standard Railway Sanitary Code the question of including regulations for the travel of venereally infected persons was thoroughly considered, and it was decided to leave them out. That anything useful can be accomplished under present conditions by such regulations seems to be almost hopeless. In spite of all laws to the contrary, the venereal diseases are usually held in secret and will not be declared. The victim is rarely obviously sick, and not often discoverable; and the number of cases is legion. The danger of such persons to fellow travelers is insignificant; for the causative organisms are among the most vulnerable of bacteria, soon losing their virulence outside of the body, and communication of the diseases is rare by any other means than by direct and intimate personal contact.

But indirect transfer by articles freshly soiled with discharges is possible and does occasionally take place. We sometimes see epidemics of gonorrhea among little girls in hospitals for children, from the soiled hands of nurses or from the common use of uncleaned bathing utensils and cloths. Among adults, only the grossest neglect and carelessness will lead to indirect infection. Syphilis is more dangerous in this regard, because of the multiplicity of its lesions and their tendency to appear outside of the genital sphere. The frequency of syphilitic sores in the mouth is the most potent argument against the common drinking cup and common towel, both of which now fortunately belong to the past. The only thing in common use in cars which is liable to contamination with venereal discharges is the toilet seat. It should be of such form as to render genital contact easily avoidable; but whatever its form, common decency should impel everyone to avoid genital contact with the seat of a public toilet, and if that is done the danger of infection practically disappears. The actual sins of the public toilet may be great enough at the best, but the transmission of venereal diseases by them is probably very rare.

There are no laws or regulations which forbid venereally infected persons to use the ordinary means of travel, though the Interstate Quarantine Regulations provide for certain restrictions the principal object of which is the securing of continued treatment. In November, 1918, a section was added to the regulations requiring that persons afflicted with venereal diseases who wish to travel shall obtain a permit from the local health officer of the jurisdiction in which he resides, that the local health officer at destination shall be immediately notified, and that the patient shall report to the latter within one week after arrival. In the recent draft of the regulations the section reads as follows:

SEC. 8. *Travel of venereally infected persons.*—(*a*) Any person infected with syphilis, gonorrhea, or chancroid who wishes to engage in interstate travel must first obtain a permit, in writing, from the local health officer under whose jurisdiction he resides. This permit shall state that, in the opinion of the health officer, such travel is not dangerous to the public health.

(*b*) Any person infected with syphilis, gonorrhea, or chancroid who wishes to change his residence from one State to another must first obtain his release, in writing, from the local health officer. He shall inform the local health officer as to the place where he intends to reside and shall agree, in writing, to report in person to the proper health officer within one week after arrival at his new residence. It shall be the duty of the health officer who issues the release to promptly notify the health officer under whose jurisdiction the infected person is to enter, of its issue. This release shall contain the name and address of the infected person. The receiving health officer shall, in turn, report the arrival of the infected person to the health officer who issued his release and notify the State health officer of his State that a person infected with venereal disease has entered his jurisdiction.

(*c*) Any person infected with syphilis, gonorrhea, or chancroid, who wishes to engage in interstate travel or change his residence shall agree to continue treatment under the direction of a reputable physician, until the health officer, or his accredited representative, shall have complied with the State board of health requirements for release of venereally infected persons.

Suggested forms for permits and for the various notifications are appended to the regulations. Some of the States have similar requirements. There has been no considerable call for the notification forms, the use of which must be practically limited to those cases being treated in the free clinics of the States, but there have been numerous instances of quarantine and detention of persons who have ignored the regulations and have refused to act in accordance with the instructions of public health officials in the continuance of treatment. But whether strictly complied with or not, such regulations can not by any means do harm, and if accompanied by an intelligent and persistent campaign along the lines of sanitation and hygiene they may ultimately do much good. If to any extent whatever they induce the continuance of treatment, they are to that extent useful, and there is sufficient evidence that they have done so in many instances. At any rate, the educational campaign now being carried on throughout a large part of the world should go on and be increased, in the hope that it may eventually result in the successful, if long delayed, control of the venereal diseases.

6. MISCELLANEOUS DISEASES.

There have been considered in the foregoing groups all those infectious diseases which by reason of their frequency, their general distribution, or their danger of communication under the circumstances of travel are likely to give rise to passenger traffic problems. Other communicable diseases are rarely dealt with specifically by the laws or regulations concerning railway travel of the States, though many States have more or less drastic general restrictions covering all infectious diseases.[46] A few other specific diseases have, however, been included in certain official restrictions and deserve a word of comment.

The Interstate Quarantine Regulations include Rocky Mountain spotted fever and anthrax in the group to be controlled as are the sputum-borne diseases; that is, cases must be isolated in a separate compartment, be in charge of a skilled attendant, and the sputum and nasal discharges must be disinfected or destroyed. There will rarely be occasion for railway travel by cases of either of these diseases. The first is restricted to a relatively small area of the region that gives it its name, the cases are usually found among ranchmen or other rural inhabitants, are acute, of relatively short duration, and often fatal. Of anthrax we have very few cases anywhere, and those few are mostly among the industrial population of the cities and in easy reach of hospital care.

---

[46] See page 10.

If cases of either of these diseases are transported, they should be isolated and personally attended, but the other restrictions applied by the Interstate Quarantine Regulations are hardly applicable, for the sputum is not the source of infection or the means by which the diseases are carried. Rocky Mountain spotted fever is an insect-borne disease. It is not transmitted by contact, and is therefore not contagious in the ordinary sense, and there are no infectious body wastes or discharges. The infection resides in the blood, and the disease is transmitted by the bite of a tick, just as plague is borne by the flea or yellow fever and malaria by mosquitoes. Regulations which do not recognize this fact will not be effective. Patients should be made tick-free; they will then be safe passengers, but otherwise they will not; and unless ticks are removed in a most painstaking manner, such patients should not be transported.

Anthrax, on the other hand, as we see it in human beings, is a disease in which the surface of the body is commonly the seat of open sores, the discharges from which contain the infecting organism. The infection gains entrance as a rule through cuts or abrasions of the skin or mucous membranes, causing first a local and then a general disease. Safeguarding measures should be directed to collecting and destroying the surface discharges rather than the sputum, though the latter may also be infectious if there are lesions of the mucous membranes and may need to be included. The anthrax bacillus is one of the most highly resistant of all known pathogenic organisms. It may live for a long time outside the body and is not readily destroyed by drying, heat, light, or chemical agents which readily destroy other disease-producing germs. If furnishings are contaminated by anthrax discharges they may remain infected indefinitely. The transporting of anthrax cases in railway passenger cars is therefore a doubtful practice under any circumstances, and if any regulations concerning it are deemed necessary they would probably best be simple prohibitive ones, as they are now in a few of the States.[47]

Glanders is also a rare disease which occasionally comes under the official ban to travel.[47] The prohibition is right, for the disease in man is highly infectious, is readily transmitted by contact, and is almost invariably fatal. But there are so few cases that the question of transportation almost never arises.

The regulations of Delaware include erysipelas and puerperal fever in the diseases forbidden to travel. These infections with the pus-producing organisms, while serious in themselves and dangerous enough to people with open wounds who may find themselves adjacent, as in surgical or maternity wards, are not likely to be dangerous to other travelers under the usual conditions of travel if reasonable precautions are taken, and there does not seem to be sufficient reason why they should not be transported where there is need of it. They should be isolated and personally attended, and discharges from their lesions should be disinfected or destroyed.

---

[47] Delaware, New Jersey. May be carried in Delaware with the permission of the State Board of health.

Why malaria, trichinosis, hydrophobia, "tuberculosis in any of its manifestations," or trachoma should be forbidden to enter the cars of common carriers, as they are in the State of New Jersey, is difficult to see. If malaria were a rare disease there might be reason to restrain its subjects; but where the disease exists at all it is frequently the case that a large proportion of the population is infected, and for all but the relatively brief period of the paroxysm of fever most of the cases go on about their affairs, so that restraint is not feasible. Nor is it necessary. Contact with the patient himself is without danger. The disease can be contracted only from the bite of the anopheles mosquito, at an interval of some days after it has become infected by biting a malaria patient. Where mosquitoes are allowed to breed freely, malaria is likely to be prevalent, and their elimination is the only preventive measure that has ever been found to be of any considerable value. There is of course good reason why malarious patients should not migrate into regions where the anopheles abound but where there is no malaria, for from such patients the disease may gain a foothold. But this has nothing to do with the danger of their riding in cars.

Hydrophobia and trichinosis can not possibly be dangerous to other travelers. Neither disease is transmitted directly from one person to another.

In the case of trachoma, an infectious disease of the eyes, there would be reason for excessive caution if the common towel were still in use; but with the abolition of that, the danger practically disappears under the ordinary conditions of travel. Eye to eye transfer of the virus, directly or through some indirect agency, is required for the infection to take place; and the common towel is practically the only means of bringing this about, at least on board a train. But aside from the danger that might arise, the trachomatous patient is neither sick nor ordinarly discoverable, and he will rarely be amenable to regulatory measures.

For those who are sick of the noncommunicable diseases the necessities in travel are only those which will give to them a reasonable degree of comfort and will not too greatly interfere with the comfort of other travelers. If the illness is so severe as to be entirely disabling, the patient should have a compartment to himself and be accompanied by an attendant, for there is no one in charge of regular railway travel who is either skilled enough, interested enough, or has time enough to attend to more than the simplest of sick people's wants. The noninfectious sick who are able to care for themselves should be allowed to travel as healthy people do.

CASES DISCOVERED EN ROUTE.

The suspicion or discovery of a case of one of the dangerous communicable diseases among railway passengers always gives rise to an uncomfortable situation for those in charge of the operation of trains, because of the possibility that train movement may be interfered with. One object to be attained in the handling of such cases is to limit interference with traffic and with the comfort and convenience of other passengers to the minimum consistent with the safety of the public health. The first essential is for the person in charge to get competent medical advice, so that he may know what his problem is. The railways generally have extensive medical organizations, and some member of the staff can usually be reached by wire without unreasonable delay. If there is space available in which isolation of the suspect can be carried out quietly, this should be done while medical aid is being awaited; but if much commotion is necessary things may be best let alone until final action can be taken.

The final disposition of such cases will always lie with the public health officials, and the most direct means possible of calling them into consulation should be utilized. The railroad surgeon may make the diagnosis, may institute isolation and provide for temporary care, but in all States and all communities the communicable diseases are subject to quarantine regulations which must be carried out under the supervision of a health officer. A reasonable attempt at providing proper care for an afflicted person is all that is demanded up to the time such as officer becomes available, but after that time his judgment must be followed and the case disposed of according to his orders.

Many of the States have provisions in their quarantine laws specifically relating to cases of infectious diseases discovered on railway trains in transit. The State board of health is usually given very broad powers in dealing with such cases. A common provision of the laws is to the effect that the car occupied by such a passenger may be detained on any siding, held in isolation, fumigated, disinfected, or otherwise disposed of under such rules as the board of health deems necessary under the circumstances. In some States the railway conductor who discovers or suspects that he is carrying an infectious passenger is required to notify by telegraph or telephone the nearest public-health officer and to take orders from him concerning the disposition of both the passenger and the car. In one State[48] the carrier is required to return the patient to the point of his departure, though no rules or regulations are provided governing the manner in which the return transportation is to be carried out so as to protect the public.

---

[48] Nebraska.

The Standard Railway Sanitary Code and the Interstate Quarantine Regulations contain provisions giving definite instructions as to the method of procedure by the railway personnel when communicable diseases are discovered or suspected among railway travelers. The sections of the standard code dealing with the subject read as follows:

> Sec. 6. *Suspected cases.*—If a conductor or other person in charge of a railway train, car, or other conveyance, or an agent or other person in charge of a railway station, shall have any reason to suspect that a passenger or a person contemplating passage is afflicted with any of the diseases enumerated in sections 1, 3, and 4, he shall notify the nearest health officer, or company physician if the health officer is not available, by the quickest and most practicable means possible, of his suspicion; and said health officer or physician shall immediately proceed to the train, car, or other conveyance at the nearest possible point, or to the railway station, to determine whether such disease exists.
>
> Sec. 7. *Disposition.*—If the health officer or physician, as provided for in section 6, shall find any such person to be afflicted with any of the diseases enumerated in sections 1, 3, and 4, he shall remove such person from the station or conveyance, or shall isolate him and arrange for his removal at the nearest convenient point; shall treat the car or other conveyance as infected premises, allowing it to proceed to a convenient place for proper treatment if in his judgment consistent with the public welfare, in such case notifying the health officer in whose jurisdiction the place is located; and shall take such other measures as will protect the public health: *Provided*, That if not prohibited in sections 1 and 2 of these regulations the afflicted person so found may be allowed to continue his travel if arrangements are made to comply, and he does so comply, with the requirements of the section of these regulations pertaining to the disease with which he is afflicted.

The above-quoted regulations apply locally in the 20 States that have officially adopted the Standard Railway Sanitary Code, namely, Alabama, Florida, Georgia, Illinois, Kansas, Kentucky, Louisiana, Maine, Maryland, Michigan, Minnesota, Mississippi, New Hampshire, North Dakota, South Carolina, Tennessee, Virginia, West Virginia, Washington, and Wisconsin. In States where there are no specific regulations, those quoted furnish a safe guide to proper practice and may be followed with assurance that all reasonable requirements are being met.

The Interstate Quarantine Regulations, applying to all interstate traffic, are practically to the same effect as the Standard Railway Sanitary Code, though cast in a somewhat different form. While it is not stated, as it is in the Standard Code, that the patient may be allowed to proceed if he is able to comply with the regulations applying to his particular disease, this must be understood; otherwise the regulations concerning the transportation of particular diseases would have no meaning. Since both codes agree in all essential requirements pertaining to the transportation of the various diseases, the handling of the matter of continuance of the journey will be the same whether the journey is intrastate or interstate. The Interstate Quarantine Regulations read as follows:

> SEC. 9. *Sick passengers en route.*—In the event of the appearance of any disease mentioned in section 1, with the exception of tuberculosis and venereal diseases, in any person aboard any car, vessel, vehicle, or conveyance operating in interstate traffic, the common carrier shall at once isolate the sick person and remove him from the car, vessel, vehicle, or conveyance at the first convenient place at which reasonable provision may be had for the protection of the patient and the public health, and shall immediately notify the Surgeon General of the United States Public Health Service and the State and local health officer of the place at which the person was removed from such car, vessel, vehicle, or conveyance.
>
> (*a*) In accordance with the foregoing paragraph, a yellow-fever case occurring en route shall be isolated in a compartment so screened as to prevent the entrance or exit of mosquitoes, or their access to the patient; and the patient shall not be disembarked in infectible territory unless thoroughly protected from mosquitoes, and unless permission for such disembarkation has been obtained from the State and local health officials having jurisdiction over the place of disembarkation.

CONVEYANCES VACATED BY INFECTED PERSONS.

The after care of premises vacated by cases of the communicable diseases has varied from time to time according to the prevailing belief as to the manner in which infections are commonly transmitted. It is not even now on an entirely satisfactory basis for all diseases, but as accurate knowledge of the modes of transmission of particular diseases has been acquired the details of preventing their spread have become more logical and more effective and the indications for the after care of quarters have become clearer. When we learned to a certainity that malaria and yellow fever are transmitted only by mosquitoes, it ceased to be necessary to expend efforts on sterilizing rugs and furniture; when it became apparent that most pathogenic bacteria have only a very short life outside of the body and that direct or indirect personal contact is the common means of transmitting the common infectious diseases, the after care of vacated quarters began to give way to destruction of dangerous discharges and excreta during the course of the illness.

Scarcely more than a decade ago terminal disinfection by means of fumigation was the rule after all infectious diseases; to neglect it was to indulge in criminal carelessness. When Chapin[49] first seriously questioned the usefulness of terminal fumigation, in an address before the American Medical Association in 1905, he aroused a storm of protest; but since that time the trend of thought has been gradually toward the acceptance of his view, until now there are few sanitarians who place any considerable value on terminal disinfection as a disease-preventing measure. Faith is pinned to rigid cleanliness during the course of the disease and to the immediate disinfection of discharges as they occur. Fumigation of vacated quarters has ceased to be a standard procedure in many of the larger cities and in some of the States, terminal cleansing taking its place; in some it has become entirely obsolete; and it has been found that subsequent cases do not occur more frequently in houses where fumigation is omitted than in those where it is carried out. The room itself is a very slight source of infection. This fact is so well established that the American Public Health Association[50] has gone on record against the necessity of terminal disinfection, other than that involved in thorough mechanical cleansing, after all the communicable diseases except cholera, plague, and smallpox.

---

[49] Chapin, The Fetish of Disinfection, J. A. M. A., 1906, xlvii, 574.

These new interpretations apply of course to the care of railway cars that have carried infectious diseases. The first hygienic necessity is for rigid cleanliness and the disinfection of discharges while the patient is in transit, as has been provided for in regulations already discussed; the second is for thorough mechanical cleaning when the car is vacated and has reached its terminal. For the common infectious diseases no more is required to overcome the dangers of transmission, and no more is generally demanded by the rules of boards of health. But there are still many boards of both cities and States that require terminal disinfection after most of the communicable diseases, and practically all of them require it after smallpox and a few others. There has been included, therefore, in both the Standard Railway Sanitary Code and the Interstate Quarantine Regulations, which are practically identical on this point, a requirement for terminal disinfection after all the communicable diseases for which travel regulations are made except the venereal diseases and tuberculosis. The Interstate Quarantine Regulations read as follows:

> SEC. 10. *Conveyances vacated by infected persons.*—Immediately after vacation by a person having any of the diseases mentioned in section 1, with the exception of pulmonary tuberculosis and venereal diseases, any berth, compartment, or stateroom should be closed and not again occupied until properly cleaned and disinfected, and all bedding, blankets, and linen in any such space should be laundered or otherwise thoroughly cleaned and disinfected before being again used.
>
> (*a*) In regard to a yellow-fever case, the compartment vacated by the patient shall be fumigated immediately upon disembarkation of patient in such manner as to insure the complete destruction of all mosquitoes contained therein.

It is not necessary to go into the details of mechanical cleaning here. Soap and water and physical work are its elements, sunlight and air its accessories; and the qualifying adjective, thorough, should be always kept in mind. It is a common practice of the railroads to add one of the many coal-tar disinfectants to the wash water in car cleaning. In 1 or 2 per cent solution they have a considerable bactericidal efficiency, and may be considered as adding effectiveness to the renovating process. But this can not be considered as fulfilling the conditions of the regulation. There are some parts of the car, or some things in it, that can not very well be washed—window shades, carpets, the coverings of seats, and the mattresses and pillows of sleeping cars—and some other process must be employed. The common way of carrying out general disinfection is by means of fumigation with formaldehyde gas. That is what is contemplated by the regulation. It should be so understood.

---

[50] Report of the Committee on Standard Methods for the Control of Communicable Diseases, U. S. Public Health Reports, October 12, 1917. Reprint No. 436.

In the treatment of all spaces where communicable disease patients have been, the value of sunlight as a bactericidal agent should always be kept in mind. Cars are fortunately rooms of many windows, and may often be flooded with sunlight while cleaning is going on. Advantage should be taken of this fact. Whenever possible, all movable things in the compartment should be taken out of the car where they may be better exposed. Upholstered seats, mattresses, pillows, and hangings should be placed in the sun for several hours, and should be turned over from time to time so that all sides may be equally affected.

Washable materials, such as blankets and the outer ticks of pillows (all sleeping-car pillows are supplied with double ticks), should be sent to the laundry for washing, where they will be rendered essentially sterile. All linen will be similarly treated as a matter of course, since there is no such thing as its repeated use in car service in this country.

It is not contemplated that the insect-borne diseases, plague, yellow fever, and typhus fever, will have occupied railway cars; they are not accepted for transportation under any circumstances. It has occasionally happened, however, that one of these diseases has developed in a passenger en route. The occurrence of such cases is so exceedingly rare that general rules can scarcely be made to cover the situation, which must be dealt with according to local conditions. Attention will, of course, be directed to destroying the insects concerned, if these by any chance have accompanied the patient. Formaldehyde gas will not kill them. Sulphur will do it, if burned in sufficient quantity, but it has the disadvantage of being destructive to the color of fabrics and corrosive to metals. Thorough spraying with an insecticide solution, of which the market affords a great number, will be effective if properly done. Without doubt the best insecticide is hydrocyanic acid gas, but it is so exceedingly poisonous to human beings that it can be used only under the direct supervision of experts; and even then fatal accidents may occur. In any of these cases the local board of health will, however, usually take charge; and anything they order must be done, even to the destruction by fire of bedding and furnishings, as has sometimes been demanded. If the expense is considerable, it is so seldom incurred as to be of little consequence.

APPENDIX.

INTERSTATE QUARANTINE REGULATIONS.

The Interstate Quarantine Regulations of the United States are promulgated by the Secretary of the Treasury on the advice of the United States Public Health Service under powers conferred by an act of Congress approved February 15, 1893. They have the force of law and penalties may be imposed for noncompliance. They apply to all traffic passing from one State into another.

The Interstate Quarantine Regulations now in force are the product of gradual growth by addition and revision through a long period of years. They consist of 31 sections, divided as follows: (I) Transportation of persons or things infected with communicable diseases; sections 1 to 18. (II) Water supplies; sections 19 and 20. (III) Sanitation of cars and vessels; sections 21 to 29. (IV) Sanitation of stations and camps; sections 30 and 31.

Only the first 10 sections of the regulations apply to the transportation of persons infected with communicable diseases. They are as follow:

Sec. 1. *Quarantinable diseases.*—For the purpose of interstate quarantine the following diseases shall be regarded as contagious and infectious diseases within the meaning of section 3 of the act approved February 15, 1893: Plague, cholera, smallpox, typhus fever, yellow fever, typhoid fever, paratyphoid, dysentery, pulmonary tuberculosis, leprosy, scarlet fever, diphtheria, measles, whooping cough, epidemic cerebrospinal meningitis, anterior poliomyelitis, Rocky Mountain spotted or tick fever, syphilis, gonorrhea, chancroid, anthrax, influenza, pneumonia, epidemic encephalitis, septic sore throat, rubella, and chicken pox.

Sec. 2. *Quarantinable persons or things.*—Any person or thing, either living or dead, which has been unduly exposed to or in intimate contact with or is infected with any of the diseases enumerated in section 1, except as otherwise provided in these regulations, shall be regarded as contagious or infectious until the contrary has been proved, and if found in any car, vessel, vehicle, or conveyance undergoing interstate transportation, shall be subjected to such inspection, disinfection, or other measures as may be necessary to prevent the spread of the infection from them.

Sec. 3. *Observance of travel regulations.*—Common carriers shall not knowingly accept for transportation from one State or Territory or the District of Columbia into another State of Territory or the District of Columbia any person suffering from any of the diseases mentioned in section 1, except as hereinafter provided; and no person knowing that he is in the communicable stage of any of the diseases enumerated in section 1 shall travel on any car, vessel, vehicle, or other conveyance engaging in interstate traffic, except as hereinafter provided, nor shall any parent, guardian, physician, nurse, or other person allow or procure such transportation for any minor, ward, patient, or other person under his charge.

Sec. 4. *Persons prohibited from travel.*—No person infected with plague, cholera, smallpox, yellow fever, or typhus fever shall be received by common carriers, their agents, or employees, upon any vessel, car, vehicle, or conveyance operating in interstate traffic.

Sec. 5. *Travel of lepers.*—Common carriers shall not accept for transportation or transport in interstate traffic any person known by them to be afflicted with leprosy, nor shall any person so afflicted accept such transportation except as hereinafter provided.

(*a*) A person afflicted with leprosy shall be permitted to accept transportation upon presentation of permits from the Surgeon General of the United States Public Health Service, or his accredited representative, and from the health authorities of the States, Territories, or District of Columbia to and from which he intends to travel, stating that such person may be received under such restrictions, which shall be specified in each instance, as will prevent the spread of the disease, provided such person shall have agreed in writing to comply, and does so comply, with the restrictions as specified.

(*b*) Any person who presents symptoms of leprosy, and who is traveling or who has left the State where he resides in violation of the above regulations, shall be detained; and, if proved to be a leper, shall be returned to such State or removed to such Federal station as the Secretary of the Treasury may designate, and the proper health authorities notified.

SEC. 6. *Travel of diseased persons.*—Except as prohibited in section 3 and except leprosy, pulmonary tuberculosis, and venereal diseases provided for in other paragraphs of these regulations, common carriers shall not receive upon any car, vessel, or conveyance operating in interstate traffic any person known by them to be afflicted with any of the diseases enumerated in section 1, or any person known to be a carrier of these diseases, unless removal and entrance permits have been granted by the State or local health officers at the places of departure and arrival, and unless such person is placed in a compartment separate from other passengers, is accompanied by a properly qualified nurse or other attendant, and unless such nurse or attendant has pledged himself or herself in writing to the common carrier to comply with the following regulations, and does so comply while in transit:

(*a*) Communication with the compartment within which the patient is traveling shall be restricted to the minimum consistent with the proper care and safety of the patient.

(*b*) All dishes and utensils used by the patient en route shall be placed in a 5 per cent solution of carbolic acid or other fluid of equivalent disinfecting value for at least one hour after they have been used and before being allowed to leave the compartment.

(*c*) All sputum and nasal discharges from the patient shall be received in gauze or paper, which shall be deposited in a paper bag or in a closed vessel and shall be destroyed by burning or disinfected by immersing for at least one hour in a 5 per cent solution of carbolic acid or other solution of equivalent disinfecting value.

(*d*) Said nurse or attendant shall, after performing any service to the patient, at once cleanse the hands by washing them in a 2 per cent solution of carbolic acid or other fluid of equivalent disinfecting value.

(*e*) In the case of a person afflicted with typhoid fever, paratyphoid fever, or dysentery the nurse or attendant shall pledge himself or herself in writing to the common carrier to comply with the following regulations while in transit, in addition to (*a*), (*b*), (*c*), and (*d*) of this section:

1. All urine and feces of the patient shall be received into a 5 per cent solution of carbolic acid or other fluid of equivalent disinfecting value, placed in a covered vessel, thoroughly mixed, and allowed to stand for at least two hours after the last addition thereto before being burned, destroyed, or emptied.

2. A sheet of rubber or other impervious material shall be carried and shall be spread between the sheet and the mattress of any bed that may be used by the patient while in transit.

3. Said nurse or attendant shall use all necessary precautions to prevent the access of flies to the patient or his discharges.

4. *Provided*, That if a person with typhoid, paratyphoid, or dysentry is presented at a railway station in ignorance of these regulations and his transportation is necessary as a life-saving or safeguarding measure, an emergency may be declared, and the

patient may be carried a reasonable distance in a baggage car if accompanied by an attendant responsible for his care and removal: *Provided also*, That regulations (a), (b), (c), (d), and (e) of this section shall be complied with in so far as the circumstances will allow, and that all bedding, clothing, rags, or cloths used by the patient shall be removed with him: *And provided further*, That any parts of the car which have become contaminated by any discharges of the patient shall be disinfected as soon as practicable, but not later than the end of the run, by washing with a 5 per cent solution of carbolic acid or other fluid of equivalent disinfecting value.

SEC. 7. *Travel of tuberculous persons.*—Common carriers, their agents or employees, shall not receive for interstate transportation any person known by them to be afflicted with pulmonary tuberculosis in a communicable stage unless said person is provided with (a) a sputum cup made of impervious material and so constructed as to admit of being tightly closed when not in use; (b) a sufficient supply of gauze, papers, or similar articles of the proper size to cover the mouth and nose while coughing or sneezing; (c) a heavy paper bag or other tight container for receiving the soiled gauze, paper, or similar articles; and unless such person shall obligate himself to use the articles provided for in the manner intended, and to destroy said articles by burning or to disinfect them by immersing for at least one hour in a 5 per cent solution of carbolic acid or other solution of equivalent disinfecting value in a covered vessel.

SEC. 8. *Travel of venereally infected persons.*—(a) Any person infected with syphilis, gonorrhea, or chancroid who wishes to engage in interstate travel must first obtain a permit, in writing, from the local health officer under whose jurisdiction he resides. This permit shall state that, in the opinion of the health officer, such travel is not dangerous to the public health.

(b) Any person infected with syphilis, gonorrhea, or chancroid who wishes to change his residence from one State to another must first obtain his release, in writing, from the local health officer. He shall inform the local health officer as to the place where he intends to reside, and shall agree, in writing, to report in person to the proper health officer within one week after arrival at his new residence. It shall be the duty of the health officer who issues the release to promptly notify the health officer under whose jurisdiction the infected person is to enter of its issue. This release shall contain the name and address of the infected person. The receiving health officer shall, in turn, report the arrival of the infected person to the health officer who issued his release and notify the State health officer of his State that a person infected with venereal disease has entered his jurisdiction.

(c) Any person infected with syphilis, gonorrhea, or chancroid who wishes to engage in interstate travel or change his residence shall agree to continue treatment under the direction of a reputable physician until the health officer, or his accredited representative, shall have complied with the State board of health requirements for release of venerally infected persons.

SEC. 9. *Sick passenger en route.*—In the event of the appearance of any disease mentioned in section 1, with the exception of tuberculosis and venereal diseases, in any person aboard any car, vessel, vehicle, or conveyance operating in interstate traffic, the common carrier shall at once isolate the sick person and remove him from the car, vessel, vehicle, or conveyance at the first convenient place at which reasonable provision may be had for the protection of the patient and the public health, and shall immediately notify the Surgeon General of the United States Public Health Service and the State and local health officer of the place at which the person was removed from such car, vessel, vehicle, or conveyance.

(a) In accordance with the foregoing paragraph, a yellow-fever case occurring en route shall be isolated in a compartment so screened as to prevent the entrance or exit of mosquitoes, or their access to the patient; and the patient shall not be disembarked in infectible territory unless thoroughly protected from mosquitoes, and unless permission for such disembarkation has been obtained from the State and local health officials having jurisdiction over the place of disembarkation.

SEC. 10. *Conveyances vacated by infected persons.*—Immediately after vacation by a person having any of the diseases mentioned in section 1, with the exception of pulmonary tuberculosis and venereal diseases, any berth, compartment, or stateroom should be closed and not again occupied until properly cleaned and disinfected. and all bedding, blankets, and linen in any such space should be laundered or otherwise thoroughly cleaned and disinfected before being again used.

(*a*) In regard to a yellow-fever case, the compartment vacated by the patient shall be fumigated immediately upon disembarkation of patient in such manner as to insure the complete destruction of all mosquitoes contained therein.

STANDARD RAILWAY SANITARY CODE.

What is now known as the Standard Railway Sanitary Code was originally prepared, under the simpler title of a railway sanitary code, by the committee on health and medical relief for the United States Railroad Administration. It was submitted to the Surgeon General of the United States Public Health Service, and such changes were made as were necessary to bring it into accord with the Interstate Quarantine Regulations as they then were, and was then distributed by the Director General of Railroads to the various Federal managers as a guide to standard practice. When the committee on health and medical relief was dissolved, early in 1920, the code was presented to the Conference of State and Provincial Health Authorities of North America, which, after some minor amendments, adopted it at the annual meeting in May, 1920, under its present title, and recommended that the several States adopt and promulgate it as a part of their sanitary regulations.

The purpose of this action by the Conference of State Health Authorities was to replace with a uniform code the diverse and often inconsistent regulations of the States for the sanitary control of railway traffic and to harmonize the intrastate with the interstate regulations. In accordance with the recommendation the code has been adopted and is now in effect in the following 20 States: Alabama, Florida, Georgia, Illinois, Kansas, Kentucky, Louisiana, Maine, Maryland, Michigan, Minnesota, Mississippi, New Hampshire, North Dakota, South Carolina, Tennessee, Virginia, Washington, West Virginia, Wisconsin.

The Standard Railway Sanitary Code consists of 91 sections, divided as follows: (I) Transportation of persons having communicable diseases; sections 1 to 10. (II) Water and ice supplies; sections 11 to 15. (III) Cleaning and disinfection of cars; sections 16 to 20. (IV) Sanitation of cars in service; sections 21 to 43. (V) Sanitation of railway stations; sections 44 to 72. (VI) Sanitation of construction camps; sections 73 to 91.

The first 10 sections, which apply to the transportation of persons having communicable diseases, are as follow:

SECTION 1. *Persons not allowed to travel.*—No person knowing or suspecting himself to be afflicted with plague, cholera, smallpox, typhus fever, or yellow fever shall apply for, procure, or accept transportation in any railway train, car, or other conveyance of a common carrier, nor shall any person apply for, procure, or accept such transportation for any minor, ward, patient, or other person under his charge if known or suspected to be so afflicted.

SEC. 2. *Persons not accepted for travel.*—Common carriers shall not accept for transportation in any railway train, car, or other conveyance any person known by them to be afflicted with any of the diseases enumerated in section 1.

SEC. 3. *Restricted travel.*—Common carriers shall not accept for transportation on any railway train, car, or other conveyance any person known by them to be afflicted with diphtheria, measles, scarlet fever, epidemic cerebrospinal meningitis, anterior poliomyelitis, mumps, whooping cough, influenza, pneumonia, epidemic encephalitis, septic sore throat, rubella, or chicken pox, or any person known to be a carrier of these diseases, unless such person is placed in a compartment separate from other passengers, is accompanied by a properly qualified nurse or other attendant, and unless such nurse or attendant shall agree to comply and does so comply with the following regulations:

(*a*) Communication with the compartment in which the patient is traveling shall be restricted to the minimum consistent with the proper care and safety of the patient.

(*b*) All dishes and utensils used by the patient shall be placed in a 5 per cent solution of carbolic acid or other fluid of equivalent disinfecting value for at least one hour after they have been used and before being allowed to leave the compartment.

(*c*) All sputum and nasal discharges from the patient shall be received in gauze or paper, which shall be deposited in a paper bag or in a closed vessel and shall be destroyed by burning.

(*d*) Said nurse or attendant shall, after performing any service to the patient, at once cleanse the hands by washing them in a 2 per cent solution of carbolic acid or other fluid of equivalent disinfecting value.

SEC. 4. *Typhoid and dysentery.*—Common carriers shall not accept for transportation on any railway train, car, or other conveyance any person known by them to be afflicted with typhoid fever, paratyphoid fever, or dysentery, unless said person is placed in a compartment separate from other passengers, is accompanied by a properly qualified nurse or other attendant, and unless said nurse or attendant shall agree to comply and does so comply with the following regulations:

(*a*) Communication with the compartment in which the patient is traveling shall be limited to the minimum consistent with the proper care and safety of the patient.

(*b*) All dishes and utensils used by the patient shall be placed in a 5 per cent solution of carbolic acid or other fluid of equivalent disinfecting value for at least one hour after they have been used and before being allowed to leave the compartment.

(*c*) All urine and feces of the patient shall be received into a 5 per cent solution of carbolic acid or other fluid of equivalent disinfecting value, placed in a covered vessel, thoroughly mixed, and allowed to stand for at least two hours after the last addition thereto before being emptied.

(*d*) A sheet of rubber or other impervious material shall be carried and shall be spread between the sheet and the mattress of any bed that may be used by the patient while in transit.

(*e*) Said nurse or attendant shall use all necessary precautions to prevent the access of flies to the patient or his discharges, and after performing any service to the patient shall at once cleanse the hands by washing them in a 2 per cent solution of carbolic acid or other fluid of equivalent disinfecting value.

(*f*) *Provided*, That if a person with typhoid or dysentery is presented at a railway station in ignorance of these regulations and his transportation is necessary as a lifesaving or safeguarding measure, an emergency may be declared and the patient may be carried a reasonable distance in a baggage car if accompanied by an attendant responsible for his care and removal: *Provided also*, That regulations (*a*), (*b*), (*c*), (*d*), and (*e*) of this section shall be complied with in so far as the circumstances will allow, and that all bedding, clothing, rags, or cloths used by the patient shall be removed with him: *And provided further*, That any parts of the car which have become contaminated by any discharges of the patient shall be disinfected as soon as practicable, but not later than the end of the run, by washing with a 5 per cent solution of carbolic acid or other fluid of equivalent disinfecting value.

SEC. 5. *Restricted application for transportation.*—No person knowing or suspecting himself to be afflicted with any of the diseases mentioned in sections 3 and 4 shall apply for, procure, or accept transportation in any railway train, car, or other conveyance of a common carrier, nor shall any person apply for, procure, or accept such transportation for any minor, ward, patient, or other person under his charge if known or suspected to be so afflicted unless he shall have agreed to and made all necessary arrangements for complying, and does so comply, with the regulations set forth in said sections 3 and 4.

SEC. 6. *Suspected cases.*—If a conductor or other person in charge of a railway train, car, or other conveyance of a common carrier, or an agent or other person in charge of a railway station, shall have any reason to suspect that a passenger or a person contemplating passage is afflicted with any of the diseases enumerated in sections 1, 3, and 4, he shall notify the nearest health officer, or company physician if the health officer is not available, by the quickest and most practicable means possible, of his suspicion; and said health officer or physician shall immediately proceed to the train, car, or other conveyance at the nearest possible point, or to the railway station, to determine whether such disease exists.

SEC. 7. *Disposition.*—If the health officer or physician, as provided for in section 6, shall find any such person to be afflicted with any of the diseases enumerated in sections 1, 3 and 4, he shall remove such person from the station or conveyance, or shall isolate him and arrange for his removal at the nearest convenient point; shall treat the car or other conveyance as infected premises, allowing it to proceed to a convenient place for proper treatment if in his judgment consistent with the public welfare, in such case notifying the health officer in whose jurisdiction the place is located; and shall take such other measures as will protect the public health: *Provided*, That if not prohibited in sections 1 and 2 of these regulations the afflicted person so found may be allowed to continue his travel if arrangements are made to comply, and he does so comply, with the requirements of the section of these regulations pertaining to the disease with which he is afflicted.

SEC. 8. *Leprosy.*—Common carriers shall not accept for transportation nor transport in any railway train, car, or other conveyance any person known by them to be afflicted with leprosy, unless such person presents permits from the Surgeon General of the United States Public Health Service or his accredited representative, and from the State department of health of the States from which and to which he is traveling, stating that such person may be received under such restrictions as will prevent the spread of the disease, and said restrictions shall be specified in each instance; and no person knowing or suspecting himself to be afflicted with leprosy, nor any person acting for him, shall apply for, procure, or accept transportation from any common carrier unless such permits have been received and are presented, and unless the person so afflicted agrees to comply and does so comply with the restrictions ordered. If any agent of a common carrier shall suspect that any person in a train, car, or other conveyance, or at a railway station, is afflicted with leprosy, he shall proceed as directed in the case of other suspected diseases in sections 6 and 7 of these regulations.

SEC. 9. *Pulmonary tuberculosis.*—Common carriers shall not accept for transportation any person known by them to be afflicted with pulmonary tuberculosis in a communicable stage unless said person is provided with (*a*) a sputum cup made of impervious material and so constructed as to admit of being tightly closed when not in use, (*b*) a sufficient supply of gauze, papers, or similiar articles of the proper size to cover the mouth and nose while coughing or sneezing, (*c*) a heavy paper bag or other tight container for receiving the soiled gauze, paper, or similar articles; and unless such person shall obligate himself to use the articles provided for in the manner intended, and to destroy said articles by burning or to disinfect them by immersing for at least one hour in a 5 per cent solution of carbolic acid or other solution of equivalent disinfecting value; nor shall any person knowing himself to be so afflicted apply for, procure, or accept transportation unless he shall have agreed to and made all necessary arrangements for complying and does so comply with the regulations as set forth in this section.

SEC. 10. *Conveyances vacated by infected persons.*—Immediately after vacation by a person having any of the diseases mentioned in sections 1, 3, 4, and 8, any berth, compartment, or stateroom should be closed and not again occupied until properly cleaned and disinfected, and all bedding, blankets, and linen in any such space should be laundered or otherwise thoroughly cleaned and disinfected before being again used.

ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
10 CENTS PER COPY

U

TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 130
December, 1922

STUDIES UPON LEPROSY

XXXIV. FURTHER STATISTICS OF LEPROSY IN HAWAII

By H. E. HASSELTINE, Surgeon, U. S. Public Health Service
Director, U. S. Leprosy Investigation Station

XXXV. STATISTICAL REPORT ON CASES OF LEPROSY WHICH HAVE LEFT SEGREGATION ON PAROLE

By H. E. HASSELTINE, Surgeon, U. S. Public Health Service
Director, U. S. Leprosy Investigation Station

NOV 7 - 1937

Investigations made in accordance with the Act of Congress approved March 3, 1905

WASHINGTON
GOVERNMENT PRINTING OFFICE

FURTHER STATISTICS OF LEPROSY IN HAWAII.

In Public Health Bulletin No. 33 (1910) Brinckerhoff and Reinecke presented the available statistics of leprosy in the Territory of Hawaii up to the end of 1908, and in Public Health Bulletin No. 66 (1914) McCoy gave further statistics up to the end of 1913. In this paper it is desired to record similar data up to the end of 1921. In another paper, statistics of cases of leprosy that have been allowed to leave segregation on parole will be recorded.

The paroling of apparently arrested cases of leprosy was begun in 1912. Some of these cases have suffered a relapse, and upon returning to segregation such patients have been taken up as new admissions. As a result, the gross figures require the deduction of these cases in order to represent the strictly new cases of leprosy apprehended.

In this paper the term "apprehended," does not necessarily mean arrest by process of law. It is used to designate all who have entered segregation. It should be stated here that in recent years some lepers have voluntarily entered segregation in hopes of having their disease arrested by proper treatment.

It is probable that there are errors in the figures given herein, but it is not believed that they are sufficient to impair their value to any great extent. The reliability of the data may be questionable but they are the best that can be obtained. A considerable portion of the data is based upon the statements of the patients or their relatives. Conditions influencing the information given in the tables will be discussed when considering the statistics given.

In order to give the reader a general view of the history of leprosy in Hawaii, the number of lepers apprehended in each year from 1866 to 1913, given in McCoy's paper, has been repeated here and to this the years 1914 to 1921 have been added.

TABLE 1.—*Total number of new cases.*

Year.	New cases.	Year.	New cases.	Year.	New cases.	Year.	New cases.
1866	141	1879	82	1892	109	1905	90
1867	57	1880	34	1893	210	1906	54
1868	76	1881	195	1894	137	1907	94
1869	73	1882	70	1895	106	1908	23
1870	31	1883	301	1896	147	1909	66
1871	128	1884	108	1897	126	1910	47
1872	69	1885	103	1898	80	1911	109
1873	295	1886	42	1899	58	1912	138
1874	53	1887	220	1900	102	1913	49
1875	128	1888	558	1901	86	1914	55
1876	57	1889	306	1902	87	1915	75
1877	110	1890	184	1903	121		
1878	136	1891	142	1904	96		

TABLE 1.—*Total number of new cases*—Continued.

Year.	New cases.	Readmissions.	Total admissions.	Year.	New cases.	Readmissions.	Total admissions.
1916	71	1	72	1919	98	2	100
1917	76	3	79	1920	98	4	102
1918	92	1	93	1921	100	18	118

NOTE.—Two paroled cases were readmitted without assignment of a new consecutive number, increasing the total number of readmissions to 31.

From Table 1 it is seen that the number of lepers entering segregation since 1913 has gradually increased, so that in 1921 it was double the number for 1913. Furthermore, considering the past 20 years by 5-year periods, we find that the last 5 years exceed the other periods, the totals, by 5-year periods, beginning with 1902, being 448, 339, 388, and 464, respectively. A part of the increase in the recent years may be due to the voluntary surrender of lepers, since it has become known that it is possible that the disease may be arrested by treatment and that segregation is not necessarily of lifelong duration.

TABLE 2.—*Nationality of lepers apprehended.*

Year.	Hawaiian.	Part Hawaiian.	Japanese.	Portuguese.	Filipino.	Korean.	Chinese.	European, other than Portuguese.	Porto Rican.	American.	Other Pacific Islanders.	Total.
1914	32	10	4	3	......	2	1	2	......	1	......	55
1915	52	14	2	4	......	1	......	1	......	1	......	75
1916	37	15	3	6	5	1	2	2	......	......	......	71
1917	35	15	3	7	5	3	5	2	1	......	......	76
1918	47	23	4	7	4	1	5	......	1	......	......	92
1919	63	15	6	2	6	2	......	......	3	......	1	98
1920	53	16	11	8	5	2	......	2	......	1	......	98
1921	43	22	13	6	5	3	......	2	2	3	1	100
Total	362	130	46	43	30	15	13	11	7	6	2	665

Table 2 aims to give the nationality, rather than the birthplace, of lepers segregated. A child born in Hawaii of American parents is recorded as American. Hawaiian applies only to the race which originally inhabited these islands. Part Hawaiian includes all racial mixtures in which any Hawaiian blood is present.

TABLE 3.—*Incidence by nationality.*

Nationality.	Population, census of 1920.	Lepers, 1914-1921.	Average annual incidence per 1,000.
Hawaiian	23,723	362	1.91
Part Hawaiian	18,027	130	.90
Japanese	109,274	46	.05
Portuguese	27,002	43	.21
Filipino	21,031	30	.18
Korean	4,950	15	.38
Chinese	23,507	13	.07
Caucasians other than Portuguese	22,138	17	.096
Porto Ricans	5,602	7	.16
Negro and others	658	2	.38
Total	255,912	655	.32

Table 3 shows the incidence of leprosy by nationalities during the eight years 1914 to 1921, based upon the figures of the census of 1920. The average annual incidence for this period has been 0.32 per 1,000. For the period 1901 to 1913, covered by McCoy's paper, the incidence, based on the census of 1910, was 0.42 per 1,000. Therefore, we find that the incidence rate of leprosy has decreased, though the average number of lepers segregated each year has increased. It is realized that this comparison is not very accurate by reason of the different number of years considered in each group, all rates being based upon the census falling within each period. However, considering the last two decades only, we find that for the 10 years 1912 to 1921 there were 852 lepers segregated, or an average annual incidence of 0.33 per 1,000, based on the census of 1920. For the 10 years 1902 to 1911 there were 873 lepers apprehended, which gives an average annual incidence rate of 0.45 per 1,000, based on the census of 1910. While this computation is not ideal, in that it is based on the population of a single year near the end of the decade, the same criticism applies equally in both periods under consideration.

These figures indicate that the incidence of leprosy in Hawaii is gradually lessening, and in view of the larger number of voluntary surrenders of lepers in the past three years, which would tend to maintain the rate at its former level, it is especially gratifying to the health authorities to see a decrease in incidence, even though it be small. In Table 3, Europeans and Americans are considered together to conform to the census designation "Caucasion other than Portuguese."

In McCoy's paper he states that "it sometimes happens that when leprosy is diagnosed in a foreigner, arrangements are made for returning the patient to his native land." While this would probably hold true for the first half of the period 1914 to 1921, in the latter half it does not, as the foreigner prefers to stay here in order to obtain the benefit of treatment which he may not be able to obtain in his fatherland. This also would tend to keep the incidence rate at a higher figure.

TABLE 4.—*Incidence by sex and age groups.*

Age group	1 to 5 years.		6 to 10 years.		11 to 15 years.		16 to 20 years.		21 to 25 years.		26 to 30 years.		31 to 35 years.		36 to 40 years.		41 to 45 years.		46 to 50 years.	
Sex	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.		F.
1914	....	....	....	....	6	1	4	10	9	6	2	1	4	2	3	....	....	1	4	....
1915	....	....	....	2	8	12	3	7	5	3	10	3	4	1	5	1	5	2	1	....
1916	....	1	....	3	7	6	3	6	15	6	7	1	3	2	....	1	2	1	1	....
1917	....	....	2	3	8	1	8	4	10	....	8	2	5	1	4	1	5	3	2	4
1918	....	....	1	1	12	7	8	8	8	4	6	9	5	1	6	2	5	....	1	....
1919	....	....	3	4	9	5	15	5	10	6	5	6	4	1	9	1	2	1	3	2
1920	....	1	3	2	14	9	10	9	8	4	7	2	6	1	3	2	2	....	4	1
1921	....	....	3	6	7	12	3	6	8	9	5	4	4	6	4	....	5	4	5	....
Total	....	2	12	21	71	53	54	55	73	38	50	28	35	15	34	8	26	12	21	7

TABLE 4.—*Incidence by sex and age groups*—Continued.

Age group	51 to 55 years.		56 to 60 years.		61 to 65 years.		66 to 70 years.		71 to 75 years.		76 to 80 years.		Not stated.		Total.		Grand totals year.
Sex	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
1914	....	....	....	....	1	1	....	....	....	....	....	....	....	....	33	32	55
1915	....	1	....	....	....	....	1	....	....	....	....	....	1	....	43	32	75
1916	....	1	5	....	....	....	....	....	....	....	....	....	....	....	43	28	71
1917	1	....	1	....	1	....	1	....	1	....	....	....	....	....	[illegible]	19	76
1918	3	1	2	1	1	....	....	....	....	....	....	....	....	....	58	34	92
	2	....	3	....	....	....	....	1	....	....	....	....	....	1	65	33	98
	4	1	3	....	....	1	1	....	....	....	....	....	....	....	65	33	98
	....	1	3	....	2	....	1	....	....	1	1	....	....	....	51	49	100
Total	10	5	17	1	5	2	4	1	1	1	1	....	1	1	415	250	665

Table 4 shows the incidence of leprosy in the two sexes and in different age groups, the age being that at which they entered segregation. The incidence, according to sex, has continued, as in previous years, at nearly 2 males to 1 female, though the year 1921 shows almost equal distribution between the sexes. In the age groups the females are more numerous in the age groups of 1 to 5 and 6 to 10 years, while in McCoy's paper the males predominated in the latter group. One does not usually think of leprosy as a disease of childhood or adolescence, but Table 3 shows that, for the period 1914 to 1921, 40 per cent of the lepers in Hawaii entered segregation before they reached 21 years of age, another 36 per cent entered between the ages of 21 and 36, leaving 24 per cent for what is usually considered as the last half of the allotted "threescore and ten years" of life.

TABLE 5.—*Civil state of lepers entering segregation.*

Year.	Married.	Single.	Widow or widower.	Divorced.	No information.	Total.
1914	26	28	....	....	1	55
1915	32	40	2	....	1	75
1916	26	43	2	....	....	71
1917	34	42	....	....	....	76
1918	32	55	4	1	....	92
1919	34	60	3	1	....	98
1920	23	68	5	1	1	98
1921	32	63	5	....	....	100
Total	239	399	21	3	3	665

The civil state of lepers entering segregation in the period 1914 to 1921 is shown in Table 5.

TABLE 6.—*Occupation.*

Occupation.	1914	1915	1916	1917	1918	1919	1920	1921	Total.
Barber	......	......	......	1	......	......	......	......	1
Carpenter	......	2	1	2	......	2	......	......	7
Chauffeur and teamster	......	4	2	1	1	4	4	4	20
Clerk and storekeeper	......	......	1	1	3	......	4	1	10
Cooper	......	......	......	......	......	......	......	1	1
Cowboy	2	1	......	1	......	1	......	1	6
Electrician	......	2	1	......	1	......	......	......	4
Engineer	......	......	1	......	......	......	1	......	2
Factory employee	......	1	1	1	......	......	......	......	3
Farmer and dairyman	2	1	1	......	......	8	5	4	21
Fisherman	1	1	1	1	2	1	......	......	7
Foreman	1	1	......	1	1	......	......	......	4
Gardener	......	......	......	2	......	......	......	......	2
House servant	1	3	......	1	......	......	1	1	7
Housewife	12	8	7	13	14	14	10	20	98
Inmate of industrial school	......	3	......	1	1	2	4	1	12
Janitor and sexton	1	1	......	......	......	......	1	......	3
Jockey	......	......	......	......	......	......	1	......	1
Laborers	16	12	24	21	25	18	18	25	159
Laundry worker	2	......	......	......	......	......	1	......	3
Longshoreman and stevedore	......	2	......	1	2	1	......	1	7
Machinist and mechanic	......	1	......	......	1	1	1	......	4
Moving picture operator	......	......	......	......	1	......	......	......	1
Painter	......	1	......	1	1	......	......	......	3
Printer	......	......	......	1	......	......	......	......	1
Policeman	......	......	......	......	2	......	1	......	3
Railroad employee	2	......	......	2	1	2	......	......	7
Seaman	......	2	2	1	......	......	1	1	7
Student and school child	11	12	13	15	7	6	14	15	93
Soldiers	......	......	......	......	1	1	......	......	2
Taro planter	1	......	1	......	......	......	......	......	2
Teacher	......	1	......	......	......	......	......	......	1
Telephone operator	......	......	......	......	1	......	......	1	2
No occupation, or none given	3	16	15	8	27	37	30	24	160
Total	55	75	71	76	92	98	98	100	665

Table 6 shows the occupation of lepers at the time they entered segregation.

TABLE 7.—*Association with lepers before segregation.*

Year.	Father.	Mother.	Grandparent.	Grandchild.	Sister or brother.	Son or daughter.	Uncle or aunt.	Nephew or niece.	Husband or wife.	Brother-in-law or sister-in-law.	Cousin.	Friend.	Kokua.	No association admitted.	Total.	Number of lepers in the family.								
																1	2	3	4	5	6	7	8	9
1914	...	...	...	...	7	1	2	1	1	....	1	7	...	35	55	46	6	3	...	...	...	...	...	...
1915	3	4	1	...	14	1	6	...	1	....	2	10	2	31	75	52	17	4	2	...	...	...	...	...
1916	4	2	2	...	12	1	2	...	1	....	3	2	...	42	71	51	13	6	1	...	...	...	...	...
1917	5	5	5	1	4	1	6	...	...	2	2	3	...	42	76	61	13	2	...	...	...	...	...	...
1918	3	4	1	...	13	1	12	1	...	....	5	2	1	49	92	71	14	5	1	...	1	...	...	...
1919	8	5	4	...	26	...	11	1	...	2	4	...	2	35	98	59	27	7	5	...	...	...	...	...
1920	5	5	3	1	16	3	14	2	...	2	6	1	1	39	98	69	26	3	...	...	...	...	...	...
1921	11	3	3	1	18	5	3	1	1	1	5	1	1	46	100	62	26	9	2	...	...	...	...	1
Total	39	28	19	3	110	13	56	6	4	7	28	26	7	319	665	471	142	39	11	...	1	...	...	1

Table 7 shows the acknowledged association with other lepers of those entering segregation. It is probable that some have been placed in the "No association" column because the patient has been ignorant of any association which may have occurred. Others have probably denied, or neglected to state, any association in order that relatives or friends might not be apprehended. Though the information is not as complete, nor as reliable as might be desired, it does show that in a rather large per cent of the cases the disease has been present in relatives or intimate associates. The totals in Table 7 do not necessarily represent the number of relatives suffering from leprosy, as some have two or more brothers or sisters who are lepers. The total in Table 7 shows that 110 lepers acknowledge that a brother or sister has suffered from leprosy. In some instances several brothers or sisters have been lepers.

A tabulation has been made of the total number of relatives afflicted which shows the following number, representing plural cases in the families: Brothers and sisters, 70; sons or daughters, 3; uncles or aunts, 31; nephews or nieces, 1. By adding these figures to the totals in Table 7 the total number of relatives afflicted may be obtained.

In that portion of Table 7 giving the number of cases in a family, a "family" has arbitrarily been limited to include the classes of father, mother, brother or sister, son or daughter, husband or wife. This may not include all cases actually domiciled under one roof, and, on the other hand, may include some who are not so domiciled. In six patients, admitted to segregation in the period under consideration, both parents were lepers. This statement should not be construed as showing heredity or infection at birth, as all but one of these children lived with the parents, or leprous relatives, for various periods prior to development of the disease. One case, reported by McCoy and Goodhue (Pub. Health Bull. No. 75, Jan., 1916) was born in the Molokai settlement and cared for in the settlement nursery by clean nurses until the disease was diagnosed.

As all lepers that enter segregation receive treatment, the beginning of segregation is practically the beginning of the treatment of their disease. The duration of the disease before treatment is begun is a matter of great importance, from the viewpoint of both the health authorities and the patient himself. That a patient who has shown the disease, or signs of active leprosy for several years, and during this time has lived in close association with his family and mingled with others in the community, has probably passed his disease on to a greater number of healthy persons than one who has shown signs of leprosy for only a few weeks, will be conceded by all who believe that the disease is transmissible from person to person. Though it is quite generally considered that the contagion of leprosy is comparatively slight, nevertheless the chronicity of the disease causes the period of contagion to be prolonged over a much longer time than is applicable to most of the infectious diseases. Upon the early diagnosis and prompt segregation of the cases of leprosy depends the efficiency of segregation. In the past passive resistance to the law of segregation—that is, the practice of remaining outside of segregation as long as possible—

has done much to reduce the power of the law of segregation in the prevention of the disease.

Leprosy is usually so insidious in its onset, and brings to the patient so little illness or inconvenience in its early stages, that many may have had slight evidence of the disease for some time before they are aware of the true nature of their trouble.

Since the introduction of the treatment of leprosy by chaulmoogra oil, and its derivatives, by intramuscular or intravenous injection, it has been the experience of most of those using these remedies that the early cases yield to treatment more rapidly than those of long standing. It is therefore of greater importance to the patient himself than to anyone else that he begin active and vigorous treatment as soon as he sees any evidence of the disease.

The following case is reported illustrating the result of early treatment. On August 1, 1921, a girl, 7 years of age, was brought to Kalihi Hospital by her father, a leper who had formerly been under treatment at the hospital and was discharged on parole in March, 1921. He was convinced that treatment could alleviate and control the disease. He discovered nodules on the child's ear on the morning of August 1 and at 1 p. m. brought the child to the hospital. Bacteriological examination showed the presence of *B. lepræ* in the nodules. The child was placed upon treatment at once and six weeks later the nodules had disappeared; at this time bacteriological examination was negative and has remained so. The child is still (August, 1922) under treatment, but gives every promise of being freed of her affliction.

When it becomes generally known among the classes in Hawaii that furnish the greatest number of lepers that early treatment gives a better outlook for recovery, and as a consequence the patients seek the treatment, instead of being driven to it by an officer of the law or by the advance of the disease, it may be predicted that a reduction in the incidence of leprosy greater than ever seen in these islands will become evident.

TABLE 8.—*Duration of disease before entering segregation.*

Year.	Less than 6 months.	6 to 12 months.	1 to 2 years.	2 to 3 years.	3 to 4 years.	4 to 5 years.	5 to 6 years.	6 to 7 years.	7 to 8 years.	8 to 9 years.	9 to 10 years.	10 years and over.	A lifetime.	No information.	Total.
1914	5	11	7	9	5	2	1	.....	1	1	1	3	4	5	55
1915	8	14	13	1	11	3	3	1	.....	.....	.....	4	.....	17	75
1916	16	15	12	4	1	2	1	2	.....	.....	.....	5	3	10	71
1917	11	4	17	12	2	4	1	3	.....	1	.....	2	1	18	76
1918	17	10	14	10	11	4	4	4	1	1	.....	8	.....	8	92
1919	10	13	14	15	8	3	4	2	3	1	2	6	.....	17	98
1920	15	13	21	8	6	4	4	5	1	1	1	3	3	13	98
1921	22	9	20	11	8	5	5	3	2	1	.....	6	.....	8	100
Total	104	89	118	70	52	27	23	20	8	6	4	37	11	96	665

Table 8 shows the stated duration of the disease in lepers at the time they entered segregation. The reliability of these statements may be questioned, but since I am not personally acquainted with more than one-third of the cases, I have tabulated the statements recorded in the case histories. I have divided the first year into halves to compare with similar tables of paroled cases. The "No information" column represents a considerable number of children who are too young to give reliable information and for whom no intelligent history can be obtained from others. In general, children have not had the disease as long as adults, so it is not believed that the "No information" column is made up of an undue number of advanced cases.

Table 9.—*Percentage segregated in first two years.*

Year.	Number less than 2 years.	Total number.	Percentage of total.	Percentage excluding cases giving no information.
1914	23	55	41.8	46.0
1915	35	75	46.7	60.4
1916	43	71	60.6	70.5
1917	32	76	42.1	55.2
1918	41	92	44.6	48.8
1919	37	98	37.8	40.7
1920	49	98	50.0	57.6
1921	51	100	51.0	55.4
Total	311	665	46.8	54.7

Table 9 shows the percentage of cases that have had leprosy less than two years. Comparing this with the similar table in McCoy's paper, we find that in only one year (1919) has the percentage fallen below the highest year (1910) in the period 1901 to 1913. It is very gratifying to see the gross percentage mount above 50 in 1921 while the number of "no information" cases is proportionately lower than in any other year. This is undoubtedly due to the influence of the paroling of a large number of lepers in 1920 and 1921, which has induced many suffering from the disease to surrender voluntarily.

Table 10.—*Result of the bacteriological examination at the time of entrance into segregation.*

Year.	Positive.	Negative.	No information.	Total.	Year.	Positive.	Negative.	No information.	Total.
1914	48	5	2	55	1919	74	24	0	98
1915	62	12	1	75	1920	83	13	2	98
1916	66	5	0	71	1921	71	29	0	100
1917	71	5	0	76					
1918	83	9	0	92	Total	558	102	5	665

Table 10 shows the result of the bacteriological examination at the time of entrance into segregation.

This table shows a proportionately greater number of persons declared lepers without a positive bacteriological finding in the later years. This may be attributed to two factors.

An old law of Hawaii required the finding of the lepra bacillus in order to declare a person a leper, though the present law does not require this. Overlooking the difference in the laws, the medical profession believed that the lepra bacillus must be demonstrated in order to declare the patient a leper. This question was ultimately brought for decision to the Attorney General, who ruled (February, 1919) that the law did not require the finding of the bacillus. This naturally led to a greater number of cases being pronounced leprosy upon clinical evidence alone. While it is desirable to demonstrate the presence of *B. lepræ* in every case that is declared a leper, it should be borne in mind that no laboratory test is infallible, and the failure of the laboratory man to find positive evidence of the disease does not warrant the physician in disregarding all other evidence which he may be able to gather. Many cases of anæsthetic leprosy have unmistakable signs of activity of the disease, though the lepra bacillus can not be found in them. Probably a few patients are segregated who are inactive cases, but after a period of observation these are paroled.

The other factor contributing to the increase of bacteriologically negative cases is the patients who, though bacteriologically negative, are satisfied in their own minds that they have the disease, and surrender themselves voluntarily in order to obtain the benefits of the more recently developed methods of treatment.

A small proportion of those who are bacteriologically negative upon admission are later found to harbor demonstrable lepra bacilli.

TABLE 11.—*First symptoms noted.*

Year.	Manifestations—									
	Skin lesions.			Nerve lesions.						
	Spots, macules, leucodermia, etc.	Redness and itching.	Nodules or thickening.	Swelling of different parts.	Numbness of different parts.	Contraction, atrophy or ulceration.	Paralysis.	Falling of hair.	No information.	Total.
1914	14	5	10	9	3	6	2	0	6	55
1915	17	2	16	6	3	12	4	0	15	75
1916	17	1	18	9	0	7	2	0	17	71
1917	13	6	10	15	5	9	0	0	18	76
1918	20	4	33	8	3	15	4	0	5	92
1919	20	7	20	24	2	8	2	0	15	98
1920	28	3	24	10	5	12	3	0	13	98
1921	36	1	20	14	7	13	1	1	7	100
Total	165	29	151	95	28	82	18	1	96	665

Table 11 is modeled after a similar table in McCoy's paper and gives a fair indication of the relative frequency of the first signs or symptoms noted. Without doubt there is a large source of error in this table, as the data are taken from the statements of the patients or relatives at the time of official examination. Furthermore, the tabulation is made from the case records and it is frequently difficult to determine accurately in which class the entry should be made. For instance, a record shows the case is the mixed type of leprosy, the first signs being recorded as "swelling of the face." Unless the compiler has seen the patient (and in most cases he has not) it is extremely difficult to determine whether this should be classed under "swelling of different parts" or under "nodules or thickening."

It is probable that many lepers do not recognize the very earliest symptoms or signs, and consequently give, as their first manifestations, some change that really belongs to a later stage of the disease.

TABLE 12.—*Type of leprosy segregated.*

Year.	Anæsthetic.	Nodular.	Mixed.	Not given.	Total.
1914	5	37	9	4	55
1915	20	44	10	1	75
1916	10	48	7	6	71
1917	9	58	2	7	76
1918	19	57	15	1	92
1919	25	52	21	0	98
1920	19	43	34	2	98
1921	36	43	21	0	100
Total	143	382	119	21	665

Table 12 shows the type of the disease as given in the case records for the different years. It is seen that the majority have been classed as nodular, though in the latter years there is an increase in the number of anæsthetic and mixed cases. It is believed that many cases, which should have been classed as mixed, have been classed as nodular, largely because a nodular or infiltrated area is snipped, and *B. leprae* found therein, and the examination terminated there. This belief is further supported by reading the case histories, which almost invariably describe in detail lesions on the face and upper extremities, and neglect, or describe very briefly, the lower extremities. It has been my experience that anæsthetic patches will be found more often on the legs and feet than in other portions of the body. There is also a tendency to class as nodular all cases in which the bacillus is found in the tissues, though the finding of the bacillus does not necessarily exclude the nerve type.

On the other hand, there is a tendency to class as anæsthetic all held as lepers in whom the bacillus can not be demonstrated. As a matter of fact, a large number are mixed cases, only a few early cases remaining purely nodular in type, while some early and some long standing cases are purely nerve type. One exceptional case now in segregation gives a history of having had the disease 14 years and seems to be a purely nodular case.

The expense to the Territory resulting from the segregation, care, and treatment of lepers and their children continues extremely heavy. All lepers in the Molokai settlement that desire treatment by the ethyl esters of chaulmoogra oil receive it. All lepers in segregation, both at Molokai settlement and Kalihi Hospital, are subsisted, housed, given medical attention, some means of entertainment, and an allowance of funds to purchase clothing or other necessities. The children born of leprous parents in segregation are cared for from birth by non leprous nurses in two homes, one for girls and one for boys.

The following table shows the amount spent in each fiscal year from 1913 to 1921:

TABLE 13.—*Expense of maintenance and treatment of lepers.*

Year.	Amount spent.	Number of lepers.	Per capita cost.	Year	Amount spent.	Number of lepers.	Per capita cost.
1913	$215,664.29	797	$270.60	1918	$227,184.90	728	$312.07
1914	216,578.24	780	277.66	1919	250,004.50	762	328.09
1915	184,192.93	756	243.64	1920	289,751.58	763	379.77
1916	184,353.12	748	246.46	1921	249,687.29	777	321.35
1917	179,360.34	727	248.11				

The legislature that convened in 1921 appropriated for the care and treatment of lepers and their children the sum of $576,680.15 for the two years beginning July 1, 1921.

In this table the number of lepers each year is the total number cared for during the year, considered as present 365 days in the year. The average daily census, of course, would be lower and this would raise the per capita cost. However, these figures are sufficient to show that the leper in Hawaii is well cared for, probably better cared for than this unfortunate class in most parts of the world. All the expense indicated in this table is borne by the Territory. In addition to this the United States Public Health Service furnishes medical attendance at Kalihi Hospital and a part of the medical supplies used.

A STATISTICAL REPORT ON CASES OF LEPROSY WHICH HAVE LEFT SEGREGATION ON PAROLE.

The segregated lepers of Hawaii are confined in two compounds, the Kalihi Hospital, near Honolulu, and the Territorial leper settlement on the island of Molokai. Kalihi Hospital was originally known as the Kalihi receiving station, and persons declared lepers were held there until a sufficient number were assembled to make a transfer to the settlement on Molokai. In recent years it has been required that a leper be held at Kalihi for treatment for a specified time. In some cases improvement has been so great and the evidence of active leprosy has remained absent for such long periods that such cases have been allowed to leave segregation under certain conditions. Likewise a smaller number has been paroled from the settlement on Molokai.

In 1912 the belief that some lepers had improved to such a degree that they were no longer dangerous to the public caused the policy of paroling such patients to be inagurated.

Prior to 1912 a number of cases had been discharged from the Molokai settlement, some of these having been admitted to segregation through errors in diagnosis, and others through what seems to have been deliberate misrepresentation by the patient, in order that he might enjoy the benefits of Territorial support and comparatively easy life.

Briefly, the procedure of paroling is as follows: The attending physician in charge of the case reports that the patient is fit for parole. The president of the board of health then appoints a board of three duly qualified physicians who examine the patient thoroughly and consider the history of the case. If this board of physicians finds that, in the opinion of its members, the patient may be allowed to return home without becoming a menace to others, it recommends that the patient be paroled subject to stated conditions. This recommendation goes to the board of health at its regular meeting, and if approved by this body the parole is granted.

The conditions of the parole require the patient to report to the hospital physician, or some physician designated by the board of health, at intervals which vary according to the individual case. Most of them are required to report weekly, some monthly, and others quarterly. After one year or more, if it seems advisable, the interval may be lengthened by the board of health. The treatment of a majority of paroled cases is continued when they report. The paroled case, therefore, is in a status not unlike that of an outpatient, except that he must be deemed not a menace to the public before he may go on paroled status. It is to be expected that some of these cases will relapse and have to be returned to segregation, though every effort is being made to reduce such occurrences to a reasonable minimum.

Table 1 shows that 249 paroles have been granted to 242 lepers, seven having been returned to the hospital and paroled a second time, after receiving treatment and remaining free of signs or symptoms of active disease for a reasonable time. One of these cases relapsed a second time and returned to the hospital in January, 1922, but this is not included in the table.

TABLE 1.—*Showing number of cases paroled and subsequent history.*

Year.	Number paroled.		Number relapsed.		Died on parole.		Disappeared.		Released from parole.		On parole Jan. 1, 1922.	
	Kalihi.	Molokai.	Kalihi.	Molokai.	Kalihi.	Molokai.	Kalihi.	Molokai.	Kalihi.	Molokai.	Kalihi.	Molokai.
1912	6	0	[1] 1	0	0	0	0	0	0	0	6	0
1913	5	4	1	0	0	0	0	1	2	0	2	4
1914	4	1	0	0	1	0	0	1	0	0	3	1
1915	7	14	[1] 2	3	2	0	0	5	0	0	4	11
1916	8	0	[1] 3	0	1	0	0	0	2	0	3	0
1917	5	12	0	[1] 3	0	0	0	1	1	0	4	10
1918	10	2	[1] 1	0	0	0	1	0	2	1	8	1
1919	44	12	4	1	4	2	1	2	2	0	34	9
1920	30	15	2	4	1	0	1	0	0	0	27	11
1921	70	0	6	0	0	0	0	0	0	0	64	0
Total	189	60	20	11	9	2	3	10	9	1	155	47
Grand total	249		31		11		13		10		202	

[1] Seven patients (4 Kalihi, 3 Molokai) relapsed and subsequently received a second parole, thereby making total number of persons paroled 242 and total on parole Jan. 1, 1922, 195. The 3 paroled from Molokai received their second parole from Kalihi. The small figures preceding an entry indicate the number in that entry who have received a second parole.

Eleven died while on parole, as far as can be determined, of diseases other than leprosy. Thirteen disappeared; two Orientals returned to the Orient; the others may have left the Territory, or may have died, most of them being old long-standing cases paroled from Molokai. Ten have been released from parole and are no longer under surveillance of the board of health or its agents. To obtain this release it is necessary for the patient to undergo a final examination by a board of three physicians and be recommended for release. At present the patient is kept on the paroled status at least four years, after which the patient may make application for release. Some releases have been made after a shorter time on parole on account of special circumstances connected with the case. One of the released patients is known to have died since being released, and I have been informed by a former officer of this station that he found no evidence of active leprosy in this case at autopsy. One case that was released from parole subsequently relapsed and is now under treatment in segregation.

TABLE 2.—*Nationality of paroled cases.*

Year.	Cases paroled.																		
	Kalihi.											Molokai.							
	Hawaiians.	Part Hawaiians.	Portuguese.	Japanese.	Chinese.	Korean.	Filipino.	American.	European other than Portuguese.	Porto Rican.	Total Kalihi.	Hawaiians.	Part Hawaiians.	Portuguese.	Korean.	Filipino.	European other than Portuguese.	Total Molokai.	Grand total.
1912	3	1	....	....	1	....	....	1	......	....	6	....	....	....	....	....	......	....	6
1913	4	1	....	....	....	....	....	....	......	....	5	4	....	....	....	....	......	4	9
1914	4	....	....	....	....	....	....	....	......	....	4	1	....	....	....	....	......	1	5
1915	6	1	....	....	....	....	....	....	......	....	7	14	....	....	....	....	......	14	21
1916	2	4	....	1	....	....	....	....	1	....	8	0	....	....	....	....	......	0	8
1917	....	2	....	....	1	....	....	1	1	....	5	9	1	2	....	....	......	12	17
1918	3	....	[1] 2	1	....	1	....	1	2	....	10	....	1	1	....	....	......	2	12
1919	[1] 26	9	3	2	4	....	....	....	......	....	44	4	3	2	....	2	1	12	56
1920	[2] 14	8	5	....	....	1	2	....	......	....	30	7	1	5	1	....	1	15	45
1921	41	[1] 13	2	6	1	[1] 2	2	[1] 1	......	2	70	....	....	....	....	....	......	0	70
Total	103	39	12	10	7	4	4	4	4	2	189	39	6	10	1	2	2	60	249

[1] Indicates cases paroled second time.

TABLE 3.—*Frequency of parole and recurrence, by nationalities (1912 to 1921).*

Nationality.	Number segregated.	Number paroles.	Per cent paroled.	Number of relapses.	Per cent of relapses.
Hawaiian	480	142	29.58	15	10.57
Part Hawaiian	168	45	26.79	7	15.55
Portuguese	55	22	40.00	2	4.55
Japanese	49	10	20.41	0	0.00
Chinese	22	7	31.82	1	14.30
Korean	17	5	29.41	2	40.00
Filipino	32	6	18.75	3	50.00
American	6	4	66.67	1	25.00
European other than Portuguese	12	6	50.00	0	0.00
Porto Rican	9	2	22.22	0	0.00
Other Pacific islanders	2	0	0.00	0	0.00
Total	852	249	29.23	31	12.90

TABLE 4.—*Percentage of total admissions, paroles, and relapses contributed by each nationality.*

Nationality.	Admissions.	Paroles.	Relapses.
Hawaiian	56.34	57.44	48.39
Part Hawaiian	19.72	18.18	22.58
Portuguese	6.45	8.68	6.45
Japanese	5.75	4.13	0.00
Chinese	2.58	2.90	3.42
Korean	2.00	1.65	6.45
Filipino	3.76	2.48	9.68
American	0.70	1.24	3.23
European	1.40	2.48	0.00
Porto Rican	1.06	0.83	0.00
Other Pacific islanders	0.23	0.00	0.00
Total	99.99	100.01	100.19

Table 2 shows the nationality of the paroled cases. Comparing the paroled cases with the number of lepers of each nationality entering segregation during the same period, we find that the paroles have been distributed quite proportionately among the different nationalities (Tables 3 and 4). The Chinese, Portuguese, American, and Europeans have a slightly higher percentage of paroles than the other nationalities. However, the relatively small number of individuals in each group makes the percentages of little significance.

Approximately 30 per cent of those entering segregation have been paroled. In the past three years the frequency of parole has been considerably greater. The number of recurrences would indicate that some that were paroled should have been held under observation for a longer period. It will be noted that no Japanese have yet relapsed. This may be due to the return to Japan of any Japanese paroled patient as soon as he observed evidence of relapse.

TABLE 5.—*Sex and age (at entrance to segregation) of paroled lepers.*

Age group.	1 to 5 years.		6 to 10 years.		11 to 15 years.		16 to 20 years.		21 to 25 years.		26 to 30 years.		31 to 35 years.		36 to 40 years.		41 to 45 years.	
Sex	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
1912	....	....	....	....	3	....	1	....	....	....	....	1	....	....	....	....	....	....
1913	....	....	1	....	....	....	2	....	1	2	3	....	....	....	....	....	....	....
1914	....	....	1	....	....	....	1	....	....	....	....	....	1	1	....	....	1	....
1915	....	....	....	....	3	1	1	3	2	2	....	....	1	1	1	....	1	....
1916	....	....	....	....	1	1	....	1	1	....	2	....	....	....	....	....	1	....
1917	....	....	1	....	3	2	....	....	1	1	1	....	1	....	....	....	....	....
1918	....	....	....	....	2	....	1	1	....	....	1	....	....	....	....	....	2	....
1919	1	....	2	2	2	3	3	^{1}7	7	1	2	7	....	2	5	1	3	....
1920	....	....	2	6	3	4	2	7	5	2	1	3	....	1	2	1	1	2
1921	....	1	2	2	^{1}8	9	^{1}11	7	2	3	4	6	^{2}7	....	4	1	....	....
Total	1	1	9	10	25	20	22	26	19	11	14	17	10	5	12	3	9	2

Age group.	46 to 50 years.		51 to 55 years.		56 to 60 years.		61 to 65 years.		71 to 75 years.		No information.		Total.		Grand total.
Sex	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
1912	....	....	1	....	....	....	....	....	....	....	....	....	5	1	6
1913	....	....	....	....	....	....	....	....	....	....	....	....	7	2	9
1914	....	....	....	....	....	....	....	....	....	....	....	....	4	1	5
1915	1	....	1	1	2	....	....	....	....	....	....	....	13	8	21
1916	1	....	....	....	....	....	....	....	....	....	....	....	6	2	8
1917	1	1	....	....	1	....	....	1	....	....	1	2	10	7	17
1918	....	1	1	2	^{1}1	....	....	....	....	....	....	....	8	4	12
1919	1	1	....	....	1	....	2	....	1	....	....	2	30	26	56
1920	1	....	....	....	....	....	....	....	....	....	2	....	19	26	45
1921	^{1}2	....	1	....	....	....	....	....	....	....	....	....	41	29	70
Total	7	3	4	3	5	....	2	1	1	....	3	4	142	107	249

Small figure appearing before an entry indicates the number of cases in that entry who have received a second parole.

Table 5 shows the sex and age (at entrance into segregation) of those who have been paroled. The paroles have been relatively more frequent in the female sex (136 male, 106 female) while the incidence of the disease by sex for the same period was 523 males and 329 females. Excluding the second paroles granted to a few patients who have returned to segregation and progressed to a point warranting a second parole, a comparison of the paroles and admissions by age groups is made in Table 6:

TABLE 6.—*Percentage of cases segregated and paroled, 1912 to 1921, by age groups.*

Age group.	Number segregated.	Per cent of total segregated.	Number paroled.	Per cent of total paroled.	Per cent paroled in group.
1 to 5 years	3	0.35	2	.82	66.67
6 to 10 years	46	5.39	19	7.85	41.30
11 to 15 years	146	17.14	44	18.18	30.14
16 to 20 years	155	18.19	46	19.01	29.68
21 to 25 years	138	16.20	30	12.40	21.74
26 to 30 years	96	11.27	31	12.81	32.29
31 to 35 years	63	7.39	13	5.37	20.63
36 to 40 years	55	6.57	15	6.20	27.27
41 to 45 years	45	5.28	11	4.55	24.44
46 to 50 years	36	4.20	9	3.72	25.00
51 to 55 years	21	2.46	6	2.48	28.57
56 to 60 years	23	2.69	4	1.63	17.39
61 to 65 years	11	1.29	3	1.24	27.27
66 to 70 years	7	.82			
71 to 75 years	2	.23	2	.83	100.00
76 to 80 years	2	.23			
81 to 85 years	1	.12			
Not stated	2	.23	7	2.90	285.70
Total	852	100.05	242	99.99	28.40

Table 6 shows that the percentage of parole has been highest in the youngest age group and gradually lessens until the 26 to 30 years group is reached. This group shows a sudden rise and subsequent groups show a slight rise, probably due to the smaller number under consideration. In general, the comparison would seem to warrant the deduction that the younger lepers have a slightly more favorable outlook than the older ones. The discrepancy in the "not stated" group is due to a number in this group paroled from Molokai who were of long residence there, and their records are defective. It may be stated here that 34 of the cases paroled were segregated prior to January 1, 1912, and 208 since that date.

TABLE 7.—*Civil state of paroled cases.*

Year.	Married.	Single.	Widow or Widower.	Divorced.	No information.	Total.
1912	2	4				6
1913	3	6				9
1914	3	2				5
1915	15	6				21
1916	3	4	1			8
1917	6	8			3	17
1918	7	4				11
1919	26	27	1		1	55
1920	17	25	1		2	45
1921	13	50	1	1		65
Total	95	136	4	1	6	242

Table 7 shows the civil state at time of segregation of those who have been paroled. Compared with the figures showing the civil status of those segregated during this period, it is seen that civil status has no appreciable influence on the frequency of parole.

TABLE 8.—*Occupation of paroled cases at time of segregation.*

Occupation.	1912	1913	1914	1915	1016	1917	1918	1919	1920	1921	Total
Bricklayer	......	......	......	......	......	......	......	......	......	1	1
Carpenter	......	1	......	......	1	......	1	1	......	......	4
Chauffeur and teamster	......	......	......	......	1	......	......	4	2	2	9
Clerks and storekeeper	......	......	......	......	......	......	......	2	......	1	3
Electrician	......	......	1	1	......	1	......	2	......	......	5
Farmer	......	1	......	1	......	1	1	1	......	3	8
Fisherman	......	1	......	1	1	......	......	......	......	......	3
Foreman	......	......	......	......	......	1	......	1	1	......	3
Gardener	......	......	......	......	......	......	......	1	......	......	1
House servant	......	1	......	1	......	......	......	......	......	1	3
Housewife	1	2	1	3	......	2	3	10	11	6	39
Inmate of Industrial School	......	......	......	......	......	......	......	1	......	3	4
Janitor and sexton	......	......	1	......	......	......	......	......	......	1	2
Jockey	......	......	......	......	......	......	......	......	......	1	1
Laborer	......	......	1	2	......	2	2	9	5	8	29
Machinist	......	......	......	......	......	1	......	......	1	1	3
Moving-picture operator	......	......	......	......	......	......	......	1	......	......	1
Prison guard	......	......	......	......	1	......	......	......	......	......	1
Railroad employee	......	......	......	......	1	......	1	2	1	......	5
Seaman	......	......	......	......	......	......	......	......	......	1	1
Soldier	......	......	......	......	......	......	......	......	1	1	2
Stevedore	......	......	......	......	......	......	......	......	......	1	1
Student	1	......	......	2	1	4	2	4	6	11	31
Teacher	......	......	......	......	......	......	1	......	......	......	1
Telephone operator	......	......	......	......	......	......	......	1	......	......	1
None stated	4	3	1	10	2	5	......	15	17	23	80
Total	6	9	5	21	8	17	11	55	45	65	242

Table 8 shows the occupation of the paroled cases. In most of these occupations the total number is insufficient to warrant any deductions by comparing them with the occupation of all admitted during the same period. It is noted, however, that laborers constituted 24 per cent of the admissions from 1914 to 1921, while they furnished but approximately 12 per cent of the paroled cases. Similar figures for housewives are 14.75 and 16; for students, 14 and 12.8; no occupation, 24 and 33.

TABLE 9.—*Duration of disease in paroled cases before entrance into segregation.*

Year paroled.	Less than 6 months.	½ to 1 year.	1 to 2 years.	2 to 3 years	3 to 4 years.	4 to 5 years.	5 to 6 years.	6 to 7 years.	7 to 8 years.	8 to 9 years.	9 to 10 years.	10 years and over.	A life time.	No information.	Total.
1912	2	......	2	......	......	......	......	1	......	......	1	......	......	......	6
1913	1	1	......	......	1	......	......	......	......	1	......	3	1	1	9
1914	1	2	......	2	......	......	......	......	......	......	......	......	......	......	5
1915	......	3	4	......	2	2	1	......	2	......	......	......	......	7	21
1916	2	1	2	......	2	......	......	......	......	......	......	......	......	1	8
1917	5	1	1	1	1	......	......	......	......	1	......	2	......	5	17
1918	3	2	......	2	1	1	......	......	......	......	......	......	......	2	11
1919	9	11	5	5	2	3	1	2	1	1	1	3	2	9	55
1920	11	4	6	5	3	1	......	1	......	......	......	2	3	9	45
1921	10	12	14	6	6	1	2	......	1	......	1	1	2	9	65
Total	44	37	34	21	18	8	4	4	4	3	3	11	8	43	242

Table 9 shows the duration of the disease prior to entrance to segregation of the paroled cases.

TABLE 10.—*Comparing number admitted, paroled, and relapsed, according to duration of disease before segregation (1912 to 1921).*

Duration of disease.	Number admitted.	Per cent of total admitted.	Number paroled.	Per cent of total paroled.	Per cent of group paroled.	Number relapsed.	Per cent of recurrence in those paroled.
Less than 1 year	246	28.87	81	33.47	32.93	7	8.64
1 to 2 years	133	15.61	34	14.05	25.56	5	14.70
2 to 3 years	92	10.80	21	8.68	22.82	2	9.52
3 to 4 years	74	8.68	18	7.85	24.33	3	16.66
4 to 5 years	37	4.34	8	3.30	21.63	2	25.00
5 to 6 years	36	4.20	4	1.69	11.11	2	50.00
6 to 7 years	29	3.40	4	1.69	13.79	0	.00
7 to 8 years	12	1.41	4	1.69	33.33	2	50.00
8 to 9 years	11	1.29	3	1.24	27.27	1	33.33
9 to 10 years	4	.47	3	1.24	75.00	0	.00
10 years and over	58	6.81	11	4.54	19.00	2	18.18
A lifetime	12	1.41	8	3.30	66.67	1	12.50
No information	108	12.68	43	17.76	39.81	4	9.54
Total	852	99.97	242	100.50	28.40	31	12.81

Table 10 shows that the frequency of parole is greater in those groups which have had the disease for shorter periods. With the exception of the third year group the frequency of parole decreases gradually with each year's duration of the disease until the seventh year group is reached, when it rises sharply. This apparent rise is probably due to the small number of persons in this group, though it should also be mentioned that some cases of long standing may have gone on to natural arrest of the disease and then received a parole. Furthermore, some of the cases of several years' duration at entrance to segregation may be naturally arrested cases which were declared lepers on account of contracted fingers, or other result of the disease, and later, when found to be inactive, have been paroled. This applies to some of the cases whose duration has been "a lifetime." The number giving no information as to duration of the disease should be made up of cases belonging to all groups, as some of these give no history on account of being too young to understand what is wanted, inability to understand English, or other valid reason. As to recurrences, it appears that those coming under treatment early have a lower percentage of recurrences than do those of longer duration, notwithstanding that the greatest number of recurrences occurs in the group that has had the disease less than one year. On a percentage basis, those who had the disease less than one year before entering segregation show a lower rate of recurrence than any other group, except two groups whose total paroled has been very low, and in which no recurrence has yet occurred.

Here again is evidence that the early recognition, and treatment of leprosy is the point on which most emphasis should be placed.

Putting this in another form, we find of those having the disease less than 1 year, 1 out of 3 was paroled; of those having the disease 1 to 2 years, 1 out of 4 was paroled; of those having the disease 3 to 4 years, 2 out of 9 were paroled; of those having the disease 4 to 5 years, 1 out of 5 was paroled; of those having the disease 5 to 6 years, 1 out of 10 was paroled.

It therefore seems apparent that, in the present state of our knowledge of leprosy, we shall achieve best results by bending our energies toward bringing cases under treatment as early as possible. From the standpoint of the lepers, nothing is to be gained by waiting for a positive diagnosis; the delay may result in losing everything.

There are numerous cases of leprosy now in segregation in Hawaii who have been officially examined one or more times before they were held as lepers. It may seem hard on a person to inform him that he has, or probably has, leprosy, but if his signs and symptoms warrant the suspicion of the disease, we do the patient the greatest possible favor by informing him of the fact.

During the past year a girl, who had been officially examined two years before and declared not a leper, died of leprous fever, one month after admission to segregation. She entered segregation, sick unto death, under a diagnosis of typhoid fever, which was not confirmed by laboratory test or autopsy findings. Had this girl been placed under treatment at her first examination, there is every reason to believe she would have responded favorably to treatment.

The rise in paroles after the 6 to 7 year group may be due to the small numbers in each group; and also it may be due to the "survival of the fittest" of the lepers; that is, it may be attributed to the fact that a few persons successfully combat and arrest the disease by natural means, though most of these carry serious deformities and defects.

TABLE 11.—*Duration of treatment (or segregation) of paroled cases.*

Year paroled.	Less than 6 months.	Duration in months.																		
		6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1912	...	...	...	...	...	...	...	...	...	...	2	1	...	...	...	...	...	1	1	...
1913	...	...	...	1	...	...	1	1	...	2	...	...	...	...	...	...	...	...	...	...
1914	...	...	...	...	...	...	...	1	...	...	...	...	1	...	...	1	...	...	...	1
1915	4	...	...	...	...	...	...	...	2	...	1	...	...	...	...	...	...	...	...	...
1916	1	...	1	...	...	...	...	1	...	...	...	...	1	1	...	1	...	...	...	1
1917	...	...	...	...	...	1	...	...	...	1	1	1	...	...	...	...	...	1	1	...
1918	2	...	...	1	...	...	...	1	1	...	...	1	...	...	...	1	...	...	1	1
1919	...	2	3	2	1	4	5	6	4	3	4	2	1	1	2	1	1	1	...	...
1920	2	3	2	...	2	1	...	2	2	...	...	...	2	...	1	2	2	4	1	...
1921	...	1	5	2	2	5	3	6	5	9	2	3	3	3	5	2	3	...	...	1
Total	9	6	11	6	5	11	9	18	14	15	10	8	8	5	8	8	6	7	4	4

TABLE II.—*Duration of treatment (or segregation) of paroled cases*—Continued.

Year paroled.	Duration in years.															Total.
	2¼	2½	2¾	3	3¼	3½	3¾	4	5	6	7	8	9	10	Over 10.	
1912					1											6
1913													2		2	9
1914								1								5
1915	1			1	1	1			1				1	3	5	21
1916		1														5
1917		1	1			1	1	1	1						5	17
1918						2										11
1919	1	1			1	1		2	2	1			1		2	25
1920	1	1			2	1	3	1		1	2	1	1		5	45
1921	4				1											66
Total	7	4	1	1	6	6	4	5	4	2	2	1	5	3	19	242

Table 11 shows the duration of segregation of those receiving paroles. The first two years are given in months, the second two years in quarters, and the remainder (up to 10 years) in years. The period of segregation is practically equivalent to the period of treatment, though some of the long-standing cases paroled from Molokai may not have taken our present form of treatment. The longest period of segregation was 31 years (1889 to 1920); the shortest one day, one case being paroled by the board who declared him a leper. Table 11 shows that nearly 70 per cent of those paroled were in segregation 2 years or less, and about 8 per cent over 10 years.

TABLE 12.—*Duration of segregation of relapsed cases.*

Duration (months).	Number of cases.	Duration (years).	Number of cases.	Duration of second period of treatment of those paroled twice (months).	Number of cases.
Less than 6 months	2	2	1	5	1
7 months	1	2¼	3	8	1
11 months	1	2½	2		
12 months	2	3¼	3	10	1
13 months	4	3½	1	13	1
14 months	1	3¾	3	16	1
15 months	1	8	1	17	1
17 months	1				
18 months	1				
19 months	2				
21 months	1				
Total	17		14		7

Table 12 shows the duration of segregation of those cases that relapsed. We naturally would expect to find a large proportion of the relapses in those that were treated for a short period; that is, in those we would consider as insufficiently treated cases. However, of the 168 paroled cases treated less than two years, 17 relapsed, and of 74 cases treated two years and over, 14 relapsed.

TABLE 13.—*Type of disease in paroled cases.*

Year of parole.	Anæsthetic.	Nodular.	Mixed.	Not stated.	Total.
1912	1			5	6
1913	6		2	1	9
1914	2		1	2	5
1915	15	3	2	1	21
1916	2	4	1	1	8
1917	3	9		5	17
1918	2	6		3	11
1919	21	27	3	4	55
1920	10	26	1	8	45
1921	11	33	20	1	65
Total	73	108	30	31	242

The type of the disease in the paroled cases is shown in Table 13. Though the greatest number were classed as nodular cases, when compared with the type of those admitted during the same period, we find that the anæsthetic type furnishes a relatively high proportion of the paroled cases. (Nodular cases admitted, 382; paroled, 108; anæsthetic, admitted, 143; paroled, 73; mixed, admitted, 119; paroled, 30; not stated,[1] 13; admitted, 21; paroled, 31.) It is quite generally admitted that the anæsthetic or nerve type of leprosy is the mildest form so far as life and longevity are concerned. Table 13 also shows that in the earlier years no nodular cases were paroled.

TABLE 14.—*Finding of bacilli at official examination of paroled cases.*

Year.	Positive.	Negative.	Not stated.	Total.
1912	1	5		6
1913	3	5	1	9
1914	2	3		5
1915	7	11	3	21
1916	6	2		8
1917	7	5	5	17
1918	10	1		11
1919	36	17	2	55
1920	31	12	2	45
1921	54	10	1	65
Total	157	71	14	242

Table 14 shows the result of bacteriological examination at the time of official examination, the term "official examination" being applied to the examination made when the person is officially declared a leper and placed in segregation. As it is required that all persons going on parole must show no demonstrable lepra bacilli upon examination, it naturally follows that those who have always been bacteriologically negative have a somewhat greater probability of being paroled. However, a large number of those paroled have been bacteriologically positive cases, and this finding by no means indicates that the case will not yield to treatment.

---

[1] The apparent discrepancy in the "not stated" cases is due to the fact that some of these paroled cases were admitted prior to January 1, 1912, the beginning of the period under consideration in this paper.

Table 15 gives the distribution of the first signs of the disease, and it appears that the lesions in the persons that have been paroled have been distributed approximately in the same proportion as in those admitted to segregation, with the single exception of those giving paralysis (usually local) as the first sign. This class of cases has a much greater proportion of paroles. The paralyses are usually relatively slight, many involving only the eyelids; others involve the muscles of the mouth and face.

TABLE 15.—*First evidence of disease in paroled cases.*

	Skin manifestations.			Nerve manifestations.					
	Spots, macules, leucoderma, etc.	Redness and itching.	Nodules and thickening.	Swelling of different parts.	Numbness of different parts.	Contraction, ulceration, and atrophy of different parts.	Paralysis.	No information.	Total.
1912	2						3	1	6
1913	2		1	2		2	1	1	9
1914	1	1	1		1	1			5
1915	2	2	1	2	1	6	5	2	21
1916	1		1	1	2	2		1	8
1917	4		4	3		1		5	17
1918	2	2	1	3		1		2	11
1919	17	1	4	11	3	8	2	9	55
1920	13	1	9	9		4	1	8	45
1921	17	1	16	11	3	4	5	8	65
Total	61	8	38	42	10	29	17	37	242

Table 16 shows roughly the length of time the relapsed cases were on parole. That there will be some relapses among the paroled cases is to be expected. There have been more than was anticipated, yet it is believed that considerable benefit has resulted from the adoption of the policy of paroling apparently arrested cases.

TABLE 16.—*Showing length of time relapsed cases were on parole.*

Year paroled.	Year of relapse.					
	1916	1917	1918	1919	1920	1921
1912				1		
1913				1		
1915	2	1			2	
1916		1	1		1	1
1917		2				
1918					1	
1919						5
1920						6
1921						6
Total	2	4	1	2	4	18

The first cases paroled were few and selected only after very rigid examination. These were so successful that others were paroled later, and still later, with the advent of improved methods of treatment, the requirements for parole became lèss rigid and possibly too lenient. It should be remembered, however, that the paroling of lepers, so far as concerns Hawaii, is an almost revolutionary departure from the old method of segregation for the remainder of the victim's life.

The paroled cases have done excellent work in teaching the classes in which most of the leprosy in Hawaii is found that the disease is amenable to treatment, and that the life in segregation is far better than the usually gloomy picture so often painted in books and magazine articles. This has caused a considerable number of lepers to surrender themselves and receive treatment, thereby removing dangerous cases from the community. Certainly some influence is causing the Hawaiians to change their attitude toward segregation, and it is believed that the paroled leper returning to his home, and there telling his friends of the conditions in the institution for lepers and of the effect of treatment, is responsible in large part for this change of opinion.

Methods designed to subject all patients to rigid and repeated examination before parole is recommended have been inaugurated, and it is hoped that the relapses in future paroled cases will be fewer.

SUMMARY.

1. During the 10 years (1912 to 1921 inclusive) 249 paroles were granted to 242 lepers in Hawaii.
2. During this period 31 suffered relapse and were returned to segregation; seven of these later received a second parole.
3. The nationality of the paroled cases indicates that the Caucasian race (Americans and Europeans, particularly Portuguese) have responded best to treatment.
4. Compared with the number of cases admitted during the same period the females have received a greater proportion of paroles than have the males.
5. Generally speaking, the younger age groups have furnished the greater number of paroled cases.
6. The probability of the arrest of the disease decreases in proportion to the duration of the disease before treatment is begun up to about the seventh year of the disease. Those surviving longer have a slightly more favorable outlook, probably due to their excellent resistance which has enabled them successfully to combat the disease.
7. About 70 per cent of the paroled cases were in segregation 2 years or less, 22 per cent 2 to 10 years, and 8 per cent over 10 years.
8. Approximately 10 per cent of paroled cases that were in segregation less than two years relapsed; and approximately 19 per cent of paroled cases that were in segregation two years or longer relapsed.
9. Compared with admissions, a greater proportion of the paroled cases were from those classed as the anæsthetic type of the disease.

10. In the 242 that received parole the leprosy bacillus had been found in 157 and in 14 no bacteriological record was made.

11. Generally speaking, the cases showing signs or symptoms of nerve leprosy have furnished a relatively greater number of paroles than those showing skin manifestations.

RELATED PUBLICATIONS.

Available reprints or bulletins on leprosy issued by the Public Health Service from which copies may be obtained without cost:

PUBLIC HEALTH BULLETINS.

No. 66. XXV. Immunity Studies in Leprosy. By Moses T. Clegg, George W. McCoy, and Harry T. Hollmann. XXVI. The Cultivation of Acid-fast Bacilli from Lepers by the use of Symbiotic Organisms. By George W. McCoy. XXVII. A Statistical Study of Leprosy in Hawaii. By George W. McCoy.

No. 75. XXVIII. Chaulmoogra Oil Treatment of Leprosy. By George W. McCoy and Harry T. Hollmann. XXIX. Carbon Dioxide Snow in the Treatment of Leprosy. By George W. McCoy and Harry T. Hollmann. XXX. *B. Leprae* in the Circulating Blood of Lepers. By Harry T. Hollmann. XXXI. Leprosy in a Nineteen-Months Old Child. By William J. Goodhue and George W. McCoy. XXXII. The Cultivation of a Non-Chromogenic Acid-fast Bacillus from a Case of Nodular Leprosy. By Moses T. Clegg. XXXIII. A Note Concerning the Favorable Influence of Glucose on the Growth of Acid-fasts. By George W. McCoy.

REPRINTS FROM PUBLIC HEALTH REPORTS.

No. 607. The treatment of leprosy with especial reference to some new chaulmoogra oil derivatives. By J. T. McDonald and A. L. Dean. August 20, 1920.

No. 627. An epidemiological study of an endemic focus of leprosy. By M. F. Boyd and W. F. Fox. December 17, 1920.

No. 646. Fractionation of chaulmoogra oil. By A. L. Dean and Richard Wrenshall. April 1, 1921.

ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
5 CENTS PER COPY

PURCHASER AGREES NOT TO RESELL OR DISTRIBUTE THIS
COPY FOR PROFIT.—PUB. RES. 57, APPROVED MAY 11, 1922.

∇

TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 131

DECEMBER, 1922

A STUDY OF THE POLLUTION AND NATURAL PURIFICATION OF THE OHIO RIVER

I. THE PLANKTON AND RELATED ORGANISMS

BY

W. C. PURDY
Plankton Expert, U. S. Public Health Service

OF THE A HARVARD MEDICAL SCHOOL

Prepared by Direction of
THE SURGEON GENERAL

WASHINGTON
GOVERNMENT PRINTING OFFICE
1923

TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 131

DECEMBER, 1922

A STUDY OF THE POLLUTION AND NATURAL PURIFICATION OF THE OHIO RIVER

I. THE PLANKTON AND RELATED ORGANISMS

BY

W. C. PURDY
Plankton Expert, U. S. Public Health Service

Prepared by Direction of
THE SURGEON GENERAL

WASHINGTON
GOVERNMENT PRINTING OFFICE
1923

LIBRARY OF THE HARVARD MEDICAL SCHOOL

A 32 B. 1881, 3, no. 131

CONTENTS.

Page.
Biological investigations 1
  Environment as a biological factor 1
    Physical factors 2
    Chemical factors 2
    Biological factors 3
  Significance of biological findings and purposes of the present investigation. 8
  Methods employed 13
    Plankton 13
    Bottom sediments 19
  Results of biological investigations 21
    The Ohio River 21
    The Pittsburgh district 23
      Summary of biological conditions in the Pittsburgh district 32
    The Wheeling district 34
      Summary of biological conditions in the Wheeling district 36
    The Portsmouth district 37
    The Cincinnati district 38
      Summary of biological conditions in the Cincinnati district 42
    The Louisville district 43
      Summary of biological conditions in the Louisville district 46
    The Paducah district 47
      Summary of biological conditions in the Paducah district 48
  General summary of biological investigations 49
  References 56

ILLUSTRATIONS.

Page.
Map of Ohio River district 14
Fig. 1. Planktograph of Pittsburgh district 58
2. Planktograph of Wheeling district 59
3. Planktograph of Portsmouth district 60
4. Planktograph of Cincinnati district (August–October, 1914) 61
5. Planktograph of Cincinnati district (November, 1914–January, 1915) 62
6. Planktograph of Cincinnati district (February–March, 1915) 63
7. Planktograph of Cincinnati district (April–May, 1915) 64
8. Planktograph of Cincinnati district (June–July, 1915) 65
9. Planktograph of Louisville district (September–October, 1914) 66
10. Planktograph of Louisville district (November, 1914–January, 1915) 67
11. Planktograph of Louisville district (February–March, 1915) 68
12. Planktograph of Louisville district (April–May, 1915) 69
13. Planktograph of Paducah district (September–October, 1914) 70
14. Total plankton production of Ohio River 71
15. Seasonal distribution of plankton at station 461 72
16. Seasonal distribution of plankton at station 475 73
17. Hydrographic curves showing seasonal fluctuations in discharge, thousand second-feet, of Little Miami at Plainville, Ohio, Licking at Falmouth, Ky., and Ohio at Cincinnati 74
18. Sanitary status of Ohio River as shown by the physical condition and the organisms of bottom deposits 75
19. Pollution of Ohio River as indicated by organisms in bottom sediments 76
20. Summary of results of examination of mud samples collected at stations 475 and 598 77

PREFACE.

The biological studies which are here reported were made during the years 1914 and 1915 as a part of a more comprehensive study of the pollution and natural purification of the Ohio River, under the direction of Surg. W. H. Frost. The investigation comprised:

1. A sanitary survey of the watershed with special reference to the sources and extent of pollution with domestic sewage and industrial wastes, the sources and quality of municipal water supplies, and the prevalence of water-borne infectious diseases.

2. A hydrometric study, carried out with the cooperation and guidance of the United States Geological Survey, designed to give accurate information as to the discharge of the Ohio at various points, also the velocities and corresponding times of flow between consecutive points of observation.

3. A detailed study of the conditions of pollution actually existing in the river, as shown by chemical, bacteriological, and biological (plankton) examination of samples collected from fixed sampling stations at frequent intervals throughout the period of the study.

The establishment for this study consisted of an administrative office and central laboratory at Cincinnati, Ohio, with five branch laboratories in operation during the spring and summer of 1914 at selected points from Pittsburgh to the mouth of the river. The collection and examination of chemical and bacteriological samples were begun in January, 1914, but the biological survey was necessarily begun later, on August 1, 1914. From that date until October 15, 1914, biological samples were collected regularly from sampling stations in the vicinity of each of the five laboratories, thus covering the full length of the river. On October 15 observations were discontinued except upon the stretch of river from Cincinnati to Louisville. Within this zone the observations begun in August, 1914, were continued without interruption until August 1, 1915, thus extending over a full seasonal cycle.

Owing to interruption during and since the World War, the general report upon the study as a whole is not yet completed. It seems proper, however, to publish this completed section dealing with plankton studies separately and in advance of the general report, for, although the plankton studies attain their full significance only when taken in connection with other phases of the investigation, they are sufficiently distinct in material and purpose to warrant separate publication.

A STUDY OF THE POLLUTION AND NATURAL PURIFICATION OF THE OHIO RIVER.—I. THE PLANKTON AND RELATED ORGANISMS.

BIOLOGICAL INVESTIGATIONS.

ENVIRONMENT AS A BIOLOGICAL FACTOR.

For every form of life in water there is a kind of food, a degree of temperature, a quality or quantity of air or water, a degree of light, perhaps, which is best suited to the particular requirements of the organism. In response to such favorable environment the organism thrives. Any departure from this optimum environment retards the activity of the organism. Any radical change, such as loss of food supply, or sudden extremes of heat or cold, or exposure to a toxic substance or to the attacks of an enemy, may be utterly destructive. The environment may remain essentially the same for weeks or months, changing only with the seasons, or with some similar gradual adjustment of nature, or it may be subject to continuous changes in location, in depth, in rate of movement, in amount and quality of food available, in temperature, in amount of sunlight, and in presence of enemies or of toxic substances. A large lake represents the first of these, stability of environment, while a flowing stream is the fullest expression of a condition of instability.

The plant and animal life of a flowing stream is exposed to a continuous fluctuation of the various factors constituting the environment. Not only are these factors many and varied, but the relative potency of certain ones will vary from time to time, as the moving water encounters an endless succession of physical conformations of channel, or experiences a varying chemical condition due to the continuous transformation of matter derived from many sources, or finds itself burdened with sewage, deprived of sunlight by clouds or by turbidity, subjected to changes of temperature as the seasons progress, or hampered in movement by a covering of ice which meantime reduces its supply of oxygen. Continuous change is the charm of the moving-picture panorama presented by a flowing stream, but this same source of pleasure to the nature lover becomes the vexing instability which tries the patience of the scientific student. "Nothing," says one writer, "is so constant about the environment of the flowing stream as its inconstancy. Instability is the key word of the fluviatile environment."

If the organism have sufficient powers of locomotion, it may select a place, such as a pool or a riffle, and remain there, indifferent to the continuous movement of the water. If, however, it be very small, with insufficient power of movement to resist the flow of the water, it goes wherever the water goes, and is subject to all the changes of environment encountered by the parcel of water which constitutes its home.

It is thus that minute freely floating plant and animal life of water, collectively termed the "plankton," is subject to all the varieties of environment occasioned by the changing conditions as the water progresses toward the mouth of the river. These changing conditions are physical, chemical, and biological.

PHYSICAL FACTORS.

The physical conditions are those which have to do with geographical positions and physical characteristics of the watershed and stream channel, the turbidity and temperature of the water, and access of light.

Topography, velocity of stream movement, and character of surface soil influence turbidity and determine time of passage. Geographical relation of main and tributary streams and seasonal variation affect the temperature of the environment. Sudden and disastrous change may result to the plankton from seasonal or tributary influence.

The relation of volume of water to amount of bottom area and surface exposure, and the presence of bars, islands, bowlders, dams, shallow riffles, and deep pools affect aeration, access of light, temperature, and, it may be, freedom from a near-septic condition on the bottom.

Temperature affects many plankton organisms profoundly. Usually the advent of cold weather results in large decrease in number. However, there are certains kinds that thrive best during the cooler weather of fall or spring. Comparatively few forms flourish during the degree of cold prevalent in our northern rivers. Kofoid (1903) found that when the temperature of the Illinois River fell to 45° F. there was a decrease of over 90 per cent in the total plankton yield.

CHEMICAL FACTORS.

The chemical condition of water becomes a factor in the biological life owing to the fact that all aquatic organisms, both plant and animal, require more or less oxygen; most aquatic plants require carbon dioxide; and the simpler organisms, both plant and animal, utilize to some extent certain dissolved salts and organic substances. These beginnings of life form the connecting link between the dissolved materials in the water and the larger organisms which in turn prey upon the smaller forms to a great extent.

Dissolved salts and organic matter are always present, although in varying amounts, in a stream. They are derived from natural drainage of the land and from the industrial wastes and sewage of cities. The processes of decay and bacterial activity release soluble nitrogen compounds and carbon dioxide to the water. The metabolism of certain organisms results in waste products which are food for others.

BIOLOGICAL FACTORS.

There are, furthermore, numerous interrelationships existing among the organisms themselves, constituting the biological environment. These biological relationships are concerned almost entirely with the matter of food, and are therefore reducible, in the final analysis, to terms of properly related physical and chemical environment. Organisms whose life processes are holophytic (plantlike) are able to elaborate food from dissolved inorganic materials by the aid of sunlight. The plant body thus nourished, however, becomes a prey to various minute animals, some of which are in turn devoured by larger predaceous forms. Other animals are scavengers, and find most of their food in particles of suspended organic matter and in the disintegrating remains of plants or of other animals. Various "chains of food relations" (Kofoid, 1903) are thus established, some being short and simple, while others are surprisingly long and complex, interlinked with many other food chains. Most of these chains finally end in the larger forms of aquatic life, especially fish, these in turn becoming the prey of numerous waterfowl and certain water animals, such as otter, mink, etc. Man himself is to be included among the animals that find much of their food in the larger aquatic organisms, such as fish, turtles, crabs, lobsters, and bivalves.

SIGNIFICANCE OF BIOLOGICAL FINDINGS AND PURPOSES OF THE PRESENT INVESTIGATION.

If it be true that the biological life of a stream is distinctly and profoundly affected by the numerous factors which form the environment, it follows that the organisms in a stream constitute in a general way a reflection of the prevailing environmental condition of that stream. This is true at least to the extent that the presence of any particular organism in unusual abundance is evidence of the relative potency of certain factors existing in that particular environment especially favorable to such organisms. Chief among such factors is food supply.

The securing of adequate supplies of suitable food constitutes the chief activity of practically all water organisms, particularly those of microscopic size. Comparatively speaking, little time is spent in other activities, such as mating, nest building, caring for offspring, etc., which require so large a proportion of the time and energy of larger animals, especially land forms. Microscopic life in water apparently has little else to do except to eat incessantly or assimilate continually. Reproduction by fission or by eggs usually takes place meantime, with but little cessation of the process of eating. Because of this state of affairs it becomes necessary to study with particular care the food habits of these organisms. Some of these food habits may now be briefly considered.

Plants containing chlorophyll or its equivalent require sunlight, by means of which they elaborate their food from simple substances, chiefly CO_2 and water. Thus, a week or more of clear weather is usually followed by a distinct and often remarkable increase of minute aquatic plants, unless turbidity of the water shuts out the sunlight. It will thus be seen that sunshine and turbidity of water are vitally concerned in the food supply of submerged plants.

Various organisms, such as certain rotifers, are, in part at least, herbivorous (Kofoid, 1904, p. 145), finding much of their food in these minute plants, which in turn are dependent largely on sunshine and clear water. Other organisms, notably certain crustacea, are regarded as scavengers because they consume as food the partly decayed fragments of various animal and plant forms. (Herrick, 1884, p. 124; Rafter and Baker, 1900, p. 76.) Most of the ciliates and certain of the flagellates find the greater part of their food in sewage-polluted water. They are most abundant when very large numbers of bacteria are present. Evidently some of these are bacteria eaters (Calkins, 1909, pp. 79, 106; Marsson, in Engineering News, August 31, 1911), while others probably consume suspended organic matter found in such polluted water.

Beyond the mere facts of food supply and preferred habitat, however, there is a still more important aspect of the relations of these organisms to their environment. Knowledge of foods and general activities of these various groups of organisms brings with it certain information concerning the effect of these activities upon the stream, especially in the case of a polluted stream in the course of self-purification. Briefly stated, these two biological aspects, which are distinct though intermingled, are the biological reaction to the environment of the stream and the physical and chemical reaction to the biological activities.

Sunshine and low turbidity favor the growth of diatoms and other algæ whose small size is fairly balanced by their vast numbers, and whose synthetic activity results in appreciable increase of the dissolved oxygen of the water. (Palmer, 1897.) This dissolved oxygen is not only used in the respiration of most water organisms, both plant and animal, but it is quite essential to the process of biochemial self-purification of the stream. Again, crustacea and rotifers, which find much of their food in the general detritus and suspended matter resulting from the decay of plants or other organic matter, are voracious feeders, and when present in large numbers dispose of no small amount of material in their promiscuous and continuous foraging. The organic matter thus consumed removes a considerable burden from the polluted water with corresponding improvement in its chemical and physical condition. Finally, if the water be burdened with sewage, the large amount of organic matter thus introduced is attacked by the bacteria and by hosts of larger organisms conveniently termed septic or pollutional organisms (Forbes and Richardson, 1913, pp. 498, 513) and consisting largely of ciliates and certain flagellates. These feed upon the bacteria as well as upon the organic detritus, and assist in the reduction of polluting material.

As sedimentation is often an important factor in the process of self-purification, it may be anticipated that the biological conditions existing in the bottom deposits when such deposits are present constitute an important phase of the biology of the stream.

The smaller organisms in mud, mostly animal forms, consist chiefly of worms, young mollusks, and insect larvæ and pupæ. The presence of these organisms is largely a matter of food supply, it would seem, for they are found burrowing and delving in the bottom deposits, and the fecal excretions of some of them show a large proportion of mud. Furthermore, the mud itself shows the effects of being worked over by some of these organisms, notably the oligochæte worms. Young bivalve mollusks find their chief food supply in minute organisms in the water, rather than in the mud in which they lie partly buried. In many instances the food habits of the organisms concerned are only partially known. This is particularly true of several of the insect larvæ.

The study of bottom sediments furnishes a sort of summary or average of the conditions that have affected the water while the sediments were accumulating. In the study of the Illinois River, Forbes and Richardson (1913) found that the study of the bottom sludges and deposits was highly important and that "the silt and other deposits accumulating on the bottom of a stream are in some respects more significant of its average condition than are the waters of its current." Recent study of the Potomac River (Purdy, 1916) tends to show similar importance of the bottom sediments.

It will thus be seen that the persistent presence and abundance of certain organisms, or the absence of others, or the sudden advent of certain forms in large numbers, all have a reasonably direct significance with regard both to the environmental condition and to the biological processes of purification that are operative therein.

In order that this significance may be better defined, and hence made of more service in the study of the general problem of stream economy, biological investigations of streams, especially in direct conjunction with chemical and bacteriological investigations, are highly desirable. If the activity of high bacterial content produces appreciable differences in chemical content of polluted water, it seems very probable that the diverse activities of an abundant plankton may also produce appreciable differences. That this is the true state of affairs is indicated by results from the comparatively small amount of work already done in this country, and also by the more extensive work done in Europe, especially in Germany. Whipple (1913, p. 142) says:

> An important question, and one which is of particular interest to water analysts, is the relation between the growth of organisms (plankton) and the chemical analysis of the water in which the organisms are found. Unquestionably there must be such a relation, but thus far our knowledge of the food requirements of the plankton is not sufficient to enable us to tell what this relation is.

Much additional work must be done, however, to give this undeveloped phase of water examination the same standing as that now enjoyed by the better-known chemical and bacteriological procedures. As in the case of the other biological sciences, there is required first routine observation and classification of the phenomena exhibited, together with the associated physical and chemical facts with which these phenomena may reasonably be expected to be correlated. The search for and study of such correlations may be profitably undertaken at the same time, and to this end the various aquatic organisms, including both plankton forms and population of bottom sediments, may be classified or arranged with respect to their attitude toward sewage; that is, their liking for it, indifference toward, or avoidance of it. The recording and classification of a considerable amount of observational material is a prerequisite, however, to any comprehensive generalization.

Many biologists have undertaken such a classification, regarding the organisms as "living reagents" (Kolkwitz, 1911) which react in a definite manner toward sewage or similar pollution.

Whipple (1913) showed that, in the Genesee River, the heavily polluted portion just below the Rochester sewer outfalls furnished very high numbers of bacteria and of certain ciliates and other protozoa. Some miles farther downstream, where chemical and bacteriological evidences of pollution were less apparent, these ciliates diminished greatly in numbers, and certain algæ appeared, these organisms to be followed, some miles below, by rotifers as the dominating organism, and finally by crustacea, as the water became progressively better in quality.

In an elaborate five-year study of the Illinois River for the threefold purpose of determining the biological population, studying the life histories and mutual dependencies of these organisms, and, finally, studying and analyzing the factors of environment, Kofoid (1903, 1904) made a notable contribution to our knowledge of plankton activities. Very briefly summarized, his more important findings are as follows:

1. The age of the water is a vital factor in production of plankton, a long time-factor permitting adequate decomposition of the contained organic matter, which in turn provided sufficient food, directly or indirectly, for the aquatic population. Conversely, a short time-factor is unfavorable to plankton growth.

2. There is little correlation between seasonal flux in chemical conditions (as shown by analyses) and seasonal course of plankton production. Nitrogenous matters are influenced, especially by rapid growth of diatoms, but changes are not uniform nor proportional.

3. Temperature affects plankton profoundly. It was noted that when temperature was below 45° F. (= 7° C.) the plankton content of the river channel was only 9 per cent of that present when temperatures were higher.

4. Diatoms are frequently very abundant and are of great importance and significance in the food supply of higher organisms. Abundance of other minute organisms containing chlorophyll provides food for large numbers of rotifers.

5. Aquatic insects are important by reason of many food relations connecting them with the smaller plankton organisms.

6. The presence of considerable amounts of organic matter, such as sewage, apparently initiates a well-defined series of biological events, beginning with high bacterial content and large numbers of ciliates. Minute chlorophyll-bearing organisms, both algæ and certain of the Mastigophora, then appear, to be followed usually by larger organisms (rotifers, rhizopods, and crustacea), which find most of their food in the more minute animals and plants.

7. Certain ciliates are very abundant during the height of sewage contamination and bacterial development. They are unusually important in the economy of the plankton, as they feed chiefly on bacteria, decaying organic matter, and the smaller algæ and are themselves eaten by rotifers. These ciliates are active agents in the reduction of sewage, in destruction of the bacteria of decay, and in purification of sewage-laden waters, transferring the matter therein to higher forms of animal life.

8. Plankton production is essentially rhythmic or periodic, the waves or "pulses" being from three to five weeks in duration. Amplitude of pulses is affected by local influences and by season.

Rising temperature, hydrographic stability, decaying vegetation, or access to sewage tend to increase plankton, while declining temperatures, dilution of fertilizing material, access of flood waters, and increase of current all tend to decrease plankton. Initial causes for plankton pulses are traceable through complex food relations which extend from the larger animal forms back to the minute algæ and other synthetic organisms. These in turn are dependent on sunlight and on dissolved matter in the water. Another line is traceable from certain ciliates and flagellates back through the bacteria, which owe their chief food to the contamination, usually sewage, which causes the high bacterial growth.

While the stated objects of Kofoid's investigation made no reference to any particular factor of environment, it is significant that, in a research thus disinterested, there should be frequent allusion to the evident effect of sewage contamination as expressed by the presence of large numbers of certain Mastigophora and ciliates.

Kofoid's work was completed before the opening of the Chicago Sanitary Canal, in 1900, poured a large volume of sewage into the Illinois River. It is therefore fortunate that a further investigation of this stream (Biology of the Upper Illinois, Forbes and Richardson, 1913) gives for comparison the biological conditions which prevailed after the addition of Chicago's sewage. A second object of this later study was "a description of the criteria and effects of different degrees of contamination of the natural waters of the Illinois." (Idem p. 498.) A brief summary of results is here appended:

The average amount of plankton after the opening of the canal was 5.07 c. c. per cubic meter of water, as compared with 3 c. c. per cubic meter previous to the opening. This average increase of 69 per cent was traceable to favorable plankton environment resulting when the largely increased volume of water overspread fertile bottom lands, and sewage from Chicago provided further large amounts of organic matter as food for microscopic organisms.

In correlating distinguishable stages of pollution with their respective chemical and biological characteristics, the river was divided into four sections, in the order of diminishing impurity, and designated by the terms "septic," "polluted," "contaminated," and, finally, "clean water." Analogous terms were applied to the characteristic organisms found in the respective waters. The following is a summary of the chief findings in these four zones of pollution:

Section 1.—Sanitary Canal at Lockport and Des Plaines River at Lockport. (This is about 33 miles below the source of the Sanitary Canal, which, after a flow of 38 miles, empties into the Des Plaines River at Joliet, Ill.)

Character.—Septic.

General and chemical conditions.—In canal, water clear. Offal, human excrement, and general refuse stranded or floating, but little decayed. Noticeable sewage odor. Sludge with foul odor. Dissolved oxygen averaged about 31.9 per cent of saturation. In Des Plaines River, water grayish. Decomposition well advanced. Foul privy odor. Conditions less offensive during cooler weather.

Biological content.—In canal, an occasional living fish. Many dead ones, floating or stranded alongshore. (Fish were a common Lake Michigan species.) No animal life in bottom sludges. Scattered algæ along edges of canal harbored the septic rotifer *R. actinurus* and the protozoa *Bodo*, *Vorticella*, *Oikomonas*, and *Anthophysa*, also septic. In Des Plaines River, bottom stones covered with sewage fungus (*Sphærotilus*) and blue-green algæ. *Anthophysa*, *Carchesium*, *Paramœcium*, and other septic protozoa abundant. Various less septic forms present. No fish in September, a few in November, but in dying condition. Many oligochæte and nematode worms in sludge. No mollusks or crustacea.

Section 2.—Des Plaines River at Dresden Heights (16 miles below mouth of the Sanitary Canal) and Illinois River from this point to Marseilles, a distance of 26 miles.

Character.—Polluted.

General and chemical conditions.—In Des Plaines River, water grayish, with privy odor. Dissolved oxygen averaged 13.1 per cent of saturation. In Illinois River, water grayish and clouded with tufts of sewage fungus (*Sphærotilus*). Masses of putrescent material floating on warmest days. Gas bubbles from bottom. Foul odor from both water and sludge. Dissolved oxygen ranged from 3.1 to 16.4 per cent of saturation. Unpolluted Kankakee (tributary) showed dissolved oxygen content of 108 to 127 per cent of saturation.

Biological content.—In Des Plaines River, large amounts of *Sphærotilus* and *Carchesium*. The blue-green algæ *Oscillatoria* and *Phormidium* were frequent. Other algæ present during cooler weather. No fish; no vertebrates except one frog. Many dead mollusks. Air-breathing beetles common. No sponges, hydroids, leeches, planarians, or crustaceans. In Illinois River, *Sphærotilus*, *Carchesium*, and *Vorticella* abundant. *Colpidium* and *Rotifer actinurus* present. Fish absent except an occasional specimen. Fungi and *Oscillatoria* in sludge; also immense numbers of worms (*Tubifex*). No mollusks, crayfish, or larvæ of May fly or Dragon fly. Conditions a little better in cooler weather.

Section 3.—Illinois River from Marseilles (42 miles below mouth of Sanitary Canal) to Starved Rock, a stretch of 16 miles.

Character.—Contaminated.

General and chemical conditions.—Water grayish. Disagreeable odor. No gas bubbles. Dissolved oxygen about 16 per cent of saturation. Advent of Fox River (relatively pure) and passage of main stream over dam help to improve conditions at Starved Rock, where dissolved oxygen averages 43.6 per cent of saturation near north shore (due to Fox River) and 35.9 per cent near south shore.

Biological content.—*Sphærotilus*, *Carchesium*, *Epistylis*, and other septic organisms very few. At Starved Rock the only sewage organism found is small amounts of *Sphærotilus*. Fish in small numbers along edge of river, farther downstream are found in some variety in mid-channel, and at Starved Rock are moderately abundant. Blue-green algæ (pollutional) fairly common near Marseilles, but scarce at Starved Rock, green algæ increasing meantime. Some worms (*Tubifex*) in bottom mud. Insect larvæ, snails, crawfish, leeches, etc., more numerous.

Section 4.—Illinois River from Starved Rock (58 miles below mouth of Sanitary Canal) to Chillicothe, 107 miles below the canal. This section is 49 miles long.

Character.—Relatively pure water.

General and chemical conditions.—Water very slightly grayish, nearly normal; becomes greenish toward Chillicothe, and the slight odor of sewage disappears. Only in winter do bottom sludges show offensive odor. Dissolved oxygen 22 to 28 per cent of saturation in midsummer, reaching maximum of 82 per cent in November.

Biological content.—Septic and pollutional organisms only occasional or absent. Fish numerous enough to justify commercial fishing. Green algæ predominate, the blue-greens being only occasional. Water is made green by large amount of minute chlorophyll-bearing plankton. Large variety of insect larvæ and of mussels, snails, and crustacea. Sponges, leeches, bryozoa, and planarians are fairly common. *Tubifex* is rare in bottom sediments.

This investigation thus indicates that a water burdened with sewage and "sick" according to all available evidence has meantime a characteristic biological content which is totally different from that shown in the lowest section studied, at which time the physical and chemical conditions also indicate that self-purification is far advanced. The recovering water is now 107 miles below the mouth of the Sanitary Canal, and it still has 180 miles to flow before it reaches the Mississippi River.

A considerable amount of work has been done by European investigators, especially in Germany. Kolkwitz (1911), in studying the organisms and conditions resulting from sewage pollution, divides the water into three zones—the sewage zone, with polysaprobic organisms, and transition zone, with mesosaprobic organisms, and the clean water zone, with oligosaprobic organisms. These terms have essentially the same significance as "septic," "polluted," "contaminated," and "clean water," as used by Forbes and Richardson (1913). This will be evident from the following further explanation by Kolkwitz, essentially as translated by Kuichling:

> *Polysaprobic zone.*—Characterized by multitude of Schizomycetes (bacteria), bacteria-eating Flagellata and Ciliata. * * * From a chemical standpoint this zone is also marked by the predominance of reducing and splitting processes due to lack of dissolved oxygen and to the excess of carbonic acid; also to relatively high content of decomposable food matters, which is indicated by the growth of certain organisms that may be regarded as living reagents.
>
> *Mesosaprobic zone.*—The process of decomposition has advanced to an intermediate degree. For convenience this zone will be divided into two parts, called A-mesosaprobic, and B-mesosaprobic, the first extending upstream and adjoining the polysaprobic zone, and the second extending down stream and adjoining the clean-water or oligosaprobic zone. The first part is usually characterized by the appearance of Schizophyceæ and Eumycetes, along with *Anthophysa vegetans*, *Stentor cæruleus*, *Carchesium lachmanni*, etc. Many bacteria are still present. Drainage ditches carrying imperfectly purified water are good examples of A-mesosaprobic zones. The B-mesosaprobic zone is generally distinguished by its contents of Diatomaceæ and certain Chlorophyceæ, along with Rhizopoda, certain Ciliata, Vermes, numerous Rotatoria, etc.
>
> *Oligosaprobic zone.*—Hygienic interest in the disposal of sewage generally terminates at this zone, while it begins herewith in the case of domestic water supplies. The chief characteristic of this zone is the completion of the process of mineralization; all of the more or less turbulent processes of self-purification are absent in the water itself, and the biological development is usually extensive. The appearance of certain representatives of the Peridiniales, all Charales, and certain planktonal Ciliata, Rotatoria, and Crustacea are to be regarded as characteristic.

Marsson (1911), of the royal Prussian testing station, studied the significance of plankton in maintaining purity of natural waters and the effect of sewage on these organisms. He says of the plankton:

> Its vegetable component is the fundamental food supply or condition of existence for all aquatic life. It comes from the products of the decomposition of * * * decaying animals and plants as well as from sewage. The self-purifying power of natural waters is merely the maintenance of the proper equilibrium between retrogressive and progressive metamorphosis. * * *

After designating as "Food producers" those plantlike organisms which assimilate inorganic matter and, aided by sunlight, build up organic compounds by means of chlorophyll, and further classifying as "Food consumers" all remaining organisms (chiefly animals), Marsson notes the great importance of the activity of algæ in stream economy, and remarks, concerning certain flagellates:

> The euglenas and their relatives are therefore found mainly in nauseous pools whose surface they cover with a green scum. They appear on every sewage farm and especially on the surface of sewage held in tanks. They also develop in great numbers in sluggish indentations of the banks of polluted streams, from which they are carried along by the current. When found plentifully in the plankton, they afford proof that the water has been contaminated.

In discussing "Food consumers" Marsson speaks of the consumption of bacteria by larger organisms, chiefly ciliates, and says:

> These relatively large unicellular organisms thus dominate over the other living organisms in their vicinity, according to their size, like a cannibal among fish. Many of the metazoa, including the Rotatoria, are likewise bacteria eaters and obtain their food in the same manner as the ciliates. Besides bacteria, this food material embraces other bacteria eaters, diatoms, small algæ, etc. If many bacteria eaters are found in a water, it can safely be inferred that many bacteria are present, hence also a quantity of putrefying substances. * * *

Referring to the effect on plankton of organic matter such as sewage, he says:

> It may also be said that the greater the quantity of impurities reaching a stream, the stronger will be the development of the plankton and the greater the amount of work it will have to perform by means of its nutrition and growth.

Eyferth (1900) describes many hundreds of aquatic organisms, both plants and animals, and ranging from bacteria to rotifers. He gives particular attention to the conditions of environment as shown by the preferred habitat of the various organisms, and, as far as known facts permit, states the attitude of each organism toward pollution, using the terms polysaprobic, mesosaprobic, and oligosaprobic, as suggested by Kolkwitz. Senft (1905) similarly regards many of the aquatic organisms as "living reagents" on account of their observed behavior toward pollution, and classifies them accordingly, using the terms of Kolkwitz.

Various other workers, both American and European, have commented on the observed behavior of aquatic organisms toward organic matter, and have regarded this microscopic life as a factor in the self-purification of surface waters. It seems probable that in the study of aquatic organisms we have a source of evidence relative to the true mechanism of self-purification of streams which is sufficiently important to command a respectful hearing along with the better-known evidence obtained meantime from bacteriological study and chemical examination. Referring to the advantage of maintaining a normal distribution of plant and animal life in a polluted stream to the end that organic matter in water may be most effectively disposed of, Whipple (1914, p. 82) says:

> The author believes that ultimately the great question of the permissible limit of stream pollution will be solved on this basis.

In view of all these facts it seemed highly desirable that the investigations of the pollution and self-purification of the Ohio River should include certain biological studies. The purpose of these studies may be said to have been twofold. There was first the general purpose of recording and classifying the available data as a contribution to the biology of streams in general. It was hoped that in addition an intensive study of the biology of the Ohio might furnish some information of immediate importance in the interpretation of the physical, chemical, and bacteriological data that it was proposed to assemble. This branch of the investigation was therefore organized with these two purposes in view.

METHODS EMPLOYED.

PLANKTON.

Purpose, scope, and plan of the biological work.—Recognition of the fact, often noted, that a sewage-polluted stream gradually becomes purified by natural means logically implies that the proper study of such a stream must include a careful survey of all known agents of nature which may be concerned in the purification process. With this end in view it was arranged to study the microscopic plants and animals and the related organisms predominating in the various portions of the river in order that additional data might be secured to consider in connection with the chemical and bacteriological data that were being secured meantime by a study of the same portions of the river.

Laboratories were established at six selected points along the river, as follows: (1) At Pittsburgh, where the Ohio River is formed by the confluence of the Allegheny and the Monongahela Rivers; (2) at Wheeling, 97 miles below Pittsburgh; (3) at Portsmouth, 355 miles below; (4) at Cincinnati, 480 miles; (5) at Louisville, 620 miles; and (6) at Paducah, 920 miles, respectively, down stream from Pittsburgh. The Paducah laboratory was within 47 miles of the Mississippi River, into which the Ohio River flows.

At each of these six cities several sampling stations were established in order to obtain representative samples of the water: (1) Above the city and untouched by local pollution; (2) below the city, and presumably showing the effects of any sewage, industrial waste, etc., introduced locally. Thus, at Pittsburgh, the several biological sampling points were located: (1) 12 miles up the Monongahela from the confluence at Pittsburgh, (2) 7 miles up the Allegheny, (3) 3 miles below the confluence at Pittsburgh, (4) 23 miles below the confluence. This last point also had reference to the condition of the Ohio water before the advent of the Beaver River, which entered at about 25 miles below Pittsburgh. Samples of this tributary were taken well up above the mouth to determine the biological status of this stream. Various other Ohio tributaries, regarded as important on account of their probable sanitary status or their effect as a dilution factor, were sampled in like manner.

Plankton samples were taken weekly as a rule. Bottom sediments were sampled less often—twice a month, or in some cases once a month. The time period covered was August 1 to October 15, 1914, in all stations except those near Cincinnati, where some intensive work was continued until August, 1915.

Table No. 1, given herewith, lists the 6 successive laboratories, 26 collecting stations, time periods covered, frequency of collection, and kinds of samples secured in the effort to secure an adequate and impartial biological picture of the Ohio River. These sampling points are designated on the map of the Ohio River District also.

TABLE NO. 1—*Record of biological samples.*

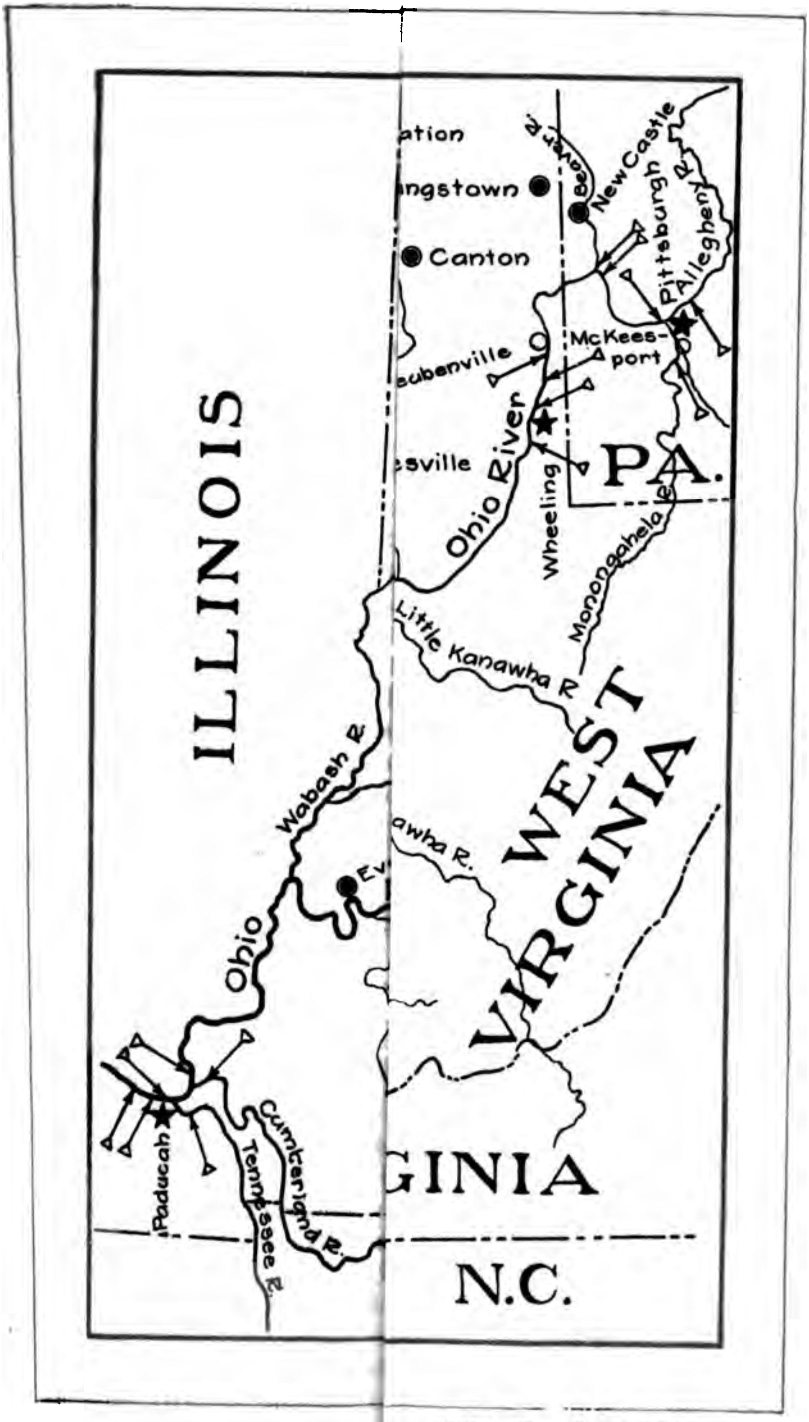
Station.	Sampling point (miles from Pittsburgh).	Time included by samples collected.	Number of samples and frequency of collection.			
			Plankton (weekly).	Mud (semi-monthly).	Miscellaneous (occasional).	Total.
Pittsburgh	M-12	Aug. 12 to Oct. 15, 1914.	10	5	1	16
	A-7	do	10	7	1	18
	O-3	do	10	7	1	18
	O-23	do	10			10
	Beaver River	do	10	5	1	16
Total			50	24	4	78
Wheeling	65	Aug. 14 to Oct. 15, 1914.	9			9
	77	do	8			8
	88	do	[1] 4			4
	97 or dam No. 13	do	10			10
Total			31			31
Portsmouth	349	Aug. 18 to Oct. 15, 1914.	7	4	1	12
	Scioto River	do	7	3		10
	358	do	7	4		11
Total			21	11	1	33
Cincinnati	461	July 22, 1914, to Aug. 1, 1915.	46	10		56
	475	do	50	[2] 84		134
	492	Sept. 10, 1914, to Aug. 1, 1915.	49	[3] 49		98
	Little Miami River	Sept. 10, 1914, to May 20, 1915.	33	1		34
	Licking River	July 22, 1914, to June 1, 1915.	36	9	1	46
	Great Miami River	Sept. 10, 1914, to Aug. 1, 1915.	39	2	1	42
Total			253	155	2	410
Louisville	598	Aug. 31, 1914, to Aug. 1, 1915.	49	[3] 87	10	146
	619, N and C	Aug. 31, 1914, to May 1, 1915.	35	34		69
	619-S	do	36	1		37
Total			120	122	10	252
Paducah	904	Sept. 2 to Oct. 12, 1914.	5	3		8
	Cumberland River	do	4	4		8
	920, N and C	do	5	3		8
	920-S	do	4			4
	Tennessee River	do	6	5		11
	926-S	do	4	6		10
	933, N and C	do	5			5
	933-S	do	5			5
Total			38	21		59
Grand total			513	333	17	863

---

[1] Biweekly.

[2] To November, 1915.

[3] To December, 1915.



15077—28. (Face p. 14.)

Plankton samples collected at the five branch laboratories were concentrated by use of the Sedgwick-Rafter filter, the resulting catch preserved by adding alcohol, and then shipped to headquarters at Cincinnati for examination. Samples of bottom sediment were preserved by alcohol and shipped to the Cincinnati laboratory for study.

Sampling.—Water samples for Plankton determination were secured by using the Dissolved Oxygen Sampler. This was a cylindrical vessel of about 3 liters capacity and constructed of copper. The air-tight, removable lid was provided with three small tubes, which extended within the vessel, permitting outflow of air and inflow of water. This sampler was lowered nearly to the bottom of the stream, then raised slowly as the water entered, displacing the air. In this manner a "vertical" sample was obtained which was made up of water from bottom to surface of the stream. In most cases, unless the stream was narrow at the sampling point, this procedure was carried out at the three points on a cross section of the channel. The final plankton sample of 2 liters was composited from the water thus obtained. Conditions of weather, stream movement, floating débris, and presence of fish and submerged plants were noted. At the laboratory these data were entered on a field card for convenient reference.

At the laboratory the 2-liter sample was concentrated by filtering through a Sedgwick-Rafter funnel, the catch preserved by the addition of strong alcohol, and labeled with name or number of the sampling station, date, amount of water filtered, and degree of concentration. Later, when the catch was measured by centrifuging, the amount of catch was also recorded on the label.

Examination.—One cubic centimeter of the catch, diluted if necessary, was placed in a Sedgwick-Rafter cell and examined with a binocular microscope magnifying 23 diameters. This was merely a rapid survey of the entire slide in order to note the chief features of the material to be studied, the uniformity of distribution over the slide, and the approximate number and kind of the larger organisms.

Further study was carried on by the aid of a Zeiss microscope with two-thirds objective and No. 4 ocular, giving a magnification of about 60 diameters. The count is made by means of a micrometer eyepiece according to the method given by Whipple (1914), 10 fields uniformly distributed over the slide being examined and the results tabulated.

Identification of organisms.—The organisms comprise eight general divisions, as follows: Diatomaceæ, Algæ, Fungi, Rhizopoda, Mastigophora (or Flagellates), Ciliata, Rotifera, and Crustacea. To these is added a division to include the various minute worms, eggs, spores, or other unclassified organisms that occasionally appear in the plankton. Each of these main divisions consists of several groups, and these are, in turn, divided into other groups or families, with further division into genera and finally species.

Identification has been facilitated by reference to the following: Whipple (1914), Conn (1905) (1908), Miall (1912), Hudson and Gosse (1889), Wolle (1887) (1892) (1894), Leidy (1879), Collins (1909), Tilden (1910), Snow 1903), Eyferth (1909), Senft (1905).

Another helpful means of identifying organisms is by the use of a set of microscope slides on which are mounted for future reference the various organisms as they are encountered in the examination of catches. An organism is removed by a capillary pipette from the counting cell, placed in a few drops of dilute formalin solution in a ringed slide, the cover slip adjusted and sealed down, and the label affixed—the whole process requiring perhaps 20 minutes.

Expression of results.—Results were recorded in terms of "standard units" (a square 20 microns on a side) inasmuch as this method serves to reduce all values to a common basis, and thus shows within certain limitations the approximate relative values of organisms of various sizes and of the amorphous matter and silt as well.

The "standard unit" (Whipple, 1914) is a unit of area and makes no allowance for the thickness of the object. In order to obtain desirable volumetric data, Whipple's recommendation that the standard unit be modified somewhat in practice in case of organisms that vary a great deal in thickness has been adopted. Accordingly, the results of plankton determinations are expressed in terms of standard units which have a constant thickness of about 20 microns, or, in other words, a volume which approximates a cubic standard unit. This is practically the application of a microscopic "board foot," or rather board inch, to the measurement of plankton, and, like board measure, it is essentially volumetric. While such measurement of microscopic objects is not exact, it nevertheless is very much nearer the true values than is obtained if no consideration whatever be given the widely fluctuating dimensions that occur.

In actual practice, the approximate shapes of the various plankton organisms to be measured may be listed as: (1) Globular bodies, (2) cylinders and cones, (3) quadrangular bodies, (4) combinations and irregulars.

Class (1) includes all spheres and near spheres, such as *Volvox*, *Chlamydomonas*, *Vorticella* (heads), and many of the ciliates.

Class (2) includes certain of the diatoms, sections of alga filaments, and some flagellates. Such organisms as *Euglena*, *Cyclops*, portions of certain rotifers and worms, etc., are essentially conical in shape and may be measured accordingly. The desmid *Closterium*, for instance, is practically a double cone.

Class (3) will include such diatoms as *Navicula*, *Synedra biceps*, etc., and a few algæ such as *Scenedesmus*.

Class (4) includes a variety of organisms, a few of which may be mentioned as typical:

Paramœcium is essentially a cylinder, capped with a half sphere at each end.

Codonella is a sphere attached to a short cylinder.

Cyclops is essentially a cone, with one end rounded into a half sphere.

Synedra is a double wedge.

Rotifers are various combinations of the sphere, the cylinder, and the cone.

Many spherical organisms are very minute. *Pleurococcus* cells may be only 10 or 12 microns in diameter. Eight or more such cells will be required to form 1 cubic standard unit.

In practice, a table similar to that illustrated herewith is a great convenience and timesaver. Such a table, copied from an Engineer's Handbook, may be posted near the workbench and consulted as the count proceeds.

TABLE GIVING AREA OF CIRCLE AND VOLUME OF SPHERE AND OF CUBE FOR A GIVEN DIAMETER.

Diameter.	Area of circle.	Volume of sphere.	Volume of cube.
0.5	0.196	0.065	0.125
1.0	.7854	.5236	1
2.0	3.1416	4.185	8
3.0	7.068	14.15	27
4.0	12.566	33.42	64
5.0	19.635	65.4	125
Etc., up to 30 or 40.			

One or two specific examples will make clear the use of the above table:

(1) Suppose a *Volvox* sphere be found, measuring 22 linear standard units in diameter. A glance at the complete table shows that such an organism has a volume of 5,575 cubic standard units.

(2) A tiny section of alga (cylindrical), one-half standard unit in diameter and 15 standard units long, has a volume of about 3 cubic standard units; that is, area of end (0.196) multiplied by length (15) equals 2.9.

(3) A flagellate (the cone-shaped *Euglena,* for example) whose larger end has a diameter of 2 standard units (linear) with a total length of 6 standard units has a volume of about 6 cubic standard units. (Area of end multiplied by one-third the length.)

(4) A cyclops, whose general shape is that of a cone with rounded base, measures, say, 12 standard units (linear) in diameter at the point where the body begins to round off to form the "head end." From this point to the tip of the tail is, say, 22 standard units in length. The volume is therefore found by multiplying the area of the base by one-third the length, or 113 × 7⅓ = 829. Add to this the volume of the head end (one-half a sphere whose diameter is 12 linear

standard units) and we have 829 + 452 = 1,281 cubic standard units as the approximate volume. If egg sacs are present they may be measured separately.

By using the ocular micrometer disk devised by Whipple, the approximate volume of all plankton organisms may, with a reasonable amount of labor, be ascertained and recorded on the plankton-counting sheet, thus placing all forms, large and small, on the same volumetric basis and thereby giving an adequate representation of the relative quantitative importance of the various organisms present.

The amorphous matter and silt on the bottom of counting cell is measured in a similar manner. This material, if abundant, usually forms a partial layer of fairly uniform thickness, so the volume may be easily found by multiplying area by thickness on a given field and subtracting the total volume of plankton organisms already counted and measured in this same field. If there be but little of the amorphous matter, the discrete particles and masses in any given field may be measured as were the plankton organisms.

The errors of measurement by the foregoing procedure tend to be so related that if both organisms and amorphous matter or silt be determined by this procedure the relation between the two may be taken as approximately correct. The total volume of the catch is capable of much more accurate determination by means of the centrifuge and actual volumetric measurement, so that by applying to this volumetric measure the relative volume of plankton as determined by the count method a fair estimate of the total volume of the plankton in the catch is obtainable. This is the procedure that has been followed throughout.

Procedure with high turbidity.—Very often the turbidity is so high that it is practically impossible to filter the sample on account of the clogging of the filter by suspended matter and silt. Under such conditions it has been our practice to allow the sample to stand for a few hours, then carefully to siphon off and filter the supernatant water in the usual manner. The heavier suspended matter, which has settled to the bottom, is diluted by the addition of a measured quantity of distilled water. This is now essentially a second catch from the 2-liter sample which has just been filtered. One cubic centimeter, further diluted if necessary, is examined in the usual way in the counting cell and the results tabulated, and later added to the count of the catch obtained by filtering, after first placing both counts on a common basis. Later the settled sediments are measured and the result, reduced to like terms, is added to the quantitative data obtained by centrifuging the other portion of the catch. This material which settled to the bottom of the bottle contained, as a rule, very few organisms.

BOTTOM SEDIMENTS.

Samples.—Samples are secured by the use of a mushroom-shaped scoop dragged on the bottom of the stream by an attached rope. From the liter or two of mud thus obtained the collector takes a representative sample of about 200 c. c., which is placed in a 500 c. c. bottle and taken to the laboratory for examination. In the case of distant stations, the sample is preserved by the addition of an equal volume of strong alcohol, then shipped to the laboratory. The collector makes note of the color, the odor, and the time and place of sampling.

Examination.—The laboratory examination of these samples consists in noting the color, the odor, and the consistency or "streak." Following this, the mud is carefully washed through a fine-mesh sieve. This is accomplished by placing the mud in some such vessel as a "moist chamber"—which has perpendicular sides—running tap water into it and agitating and rotating the vessel until the water is very turbid with mud in suspension. This is then poured through the sieve. More tap water is then added, and the process repeated as often as necessary until all the mud has been passed through the sieve, whose fine meshes retain the larger organisms present (worms, insect larvæ, mollusks, etc.) and the various kinds of disintegrating organic material, chiefly fragments of leaves, plants, seeds, small sticks, molts of water animals, etc. This is essentially a process of filtration and the "catch" in the sieve is transferred to a vessel of clean water for convenient study. Results are tabulated under appropriate headings. No quantitative estimates are attempted aside from using a sample of constant size (200 c. c.). Organisms present are merely counted. Disintegrating organic material is recorded as to predominating kinds and relative abundance.

banks. The water is generally acid from mine drainage and but slightly turbid.

A slack-water basin extending nearly 5 miles below Pittsburgh (except during high water) receives these two tributaries, together with large amounts of untreated sewage and industrial wastes discharged directly into this basin along Pittsburgh's total water frontage of 31½ miles.

Finally, abundance of organic material in various stages of decomposition, restored alkaline reaction, and a considerable time element constitute a favorable environment for biological action at this point.

Samples were taken from each of the two rivers at points some distance above the point of confluence and above the portion of the Pittsburgh water front where sewage and wastes are added to the river. The sampling point for the Allegheny River is 7 miles upstream from the confluence of the two streams, and is designated by A–7. The Monongahela sampling point is 12 miles above the confluence and its designation is M–12. At O–3, 3 miles below the confluence, samples were taken to ascertain the content of the mixed waters. Similarly, O–23 designates a sampling point sufficiently far below Pittsburgh to insure thorough mixture, as well as a considerable time interval for biological action and sedimentation, through the agency of five successive pools formed by as many dams. Samples were also taken in the mouth of the Beaver River, which enters the Ohio 25 miles below Pittsburgh.

Water from these five sampling points show the biological condition of the streams on reaching the Pittsburgh district, but before the access of sewage and wastes from the city itself; after the two tributaries combine and have meantime received sewage and industrial wastes in large amount from Pittsburgh; after the complete mixing, sedimentation, and detention caused by the five dams; and at the mouth of the Beaver River.

The average results of weekly examinations made during the months of August, September, and October, 1914, are given in Table No. 6 (p. 53) and the principal features are shown graphically in planktograph No. 1 (p. 58).

Station M–12.—Ten weekly samples taken at M–12 during a period of relatively stable conditions of temperature, river stage, and turbidity showed a relatively constant content of organisms, both as to amount and kind. Organisms averaged 5.3 to 6.4 per cent of catch (monthly averages). Rotifers constituted 89 to 96 per cent of all organisms present. Lack of variety and total absence of green algæ further characterized the plankton.

This sampling point, located near the lower end of the 131-mile slack-water stretch, represents water which has been subject to heavy pollution by sewage, by industrial wastes, and by drainage from coal

RESULTS OF BIOLOGICAL INVESTIGATIONS.

In presenting the result of the biological studies of certain portions of the Ohio and its tributaries it is deemed advisable to set down in the same place a summary of those physical, chemical, and biological characteristics of the stream that may be supposed to determine or be influenced by the presence of the microscopic plant and animal life under investigation.

These various characteristics have been studied in detail and are described more fully in the separate report upon hydrometric, chemical, and bacteriological studies of the river. An effort to summarize the essential factors, giving to each its due weight, and thus to arrive at some reasonable conclusions as to the general biological situation at any given station, is a task attended by perplexing problems and real difficulties. Aquatic life responds to changes in its environment. If this environment be made up of many and diverse factors, the resulting biological situation is correspondingly complex. As stated by Kofoid (1904, p. 41), the organisms in a stream constitute "the biological expression of the state of tension among these various factors which for the moment exists," the factors referred to being a most complex series "whose number and relative potency are subject to constant change and readjustment in the unstable environment of the stream."

It will not be attempted, therefore, to analyze the environmental conditions in terms of biological activity, but rather to set down side by side a summary of the river characteristics and of the biological findings at each station in order that the way may be partially prepared for a study of whatever correlations may exist between the two. That such correlations do exist may be anticipated from general biological principles; and certain marked tendencies are plainly apparent in the data that will be presented in the following pages. It is only by the painstaking collecting, recording, and analyzing of a large amount of observational data of this sort that it will be possible to arrive at a state of knowledge of the ecology of microscopic life comparable with the similar knowledge which now exists in the case of the better-known higher plants and animals.

THE OHIO RIVER.

The Ohio River, formed in southwestern Pennsylvania by the confluence of the Allegheny and Monongahela Rivers, flows in a general southwesterly direction and empties into the Mississippi near the present city of Cairo. Its total length of 967 miles forms the dividing line between the States of Ohio, Indiana, and Illinois on the north and Kentucky and West Virginia on the south. The chief tributaries from the north are the Beaver, Muskingum, Scioto, Miami,

and Wabash Rivers; tributaries from the south are Kanawha, Licking, Kentucky, Green, Cumberland, and Tennessee Rivers.

The total area of the watershed drained by the Ohio and its tributaries is 203,000 square miles and constitutes the major portions of the States named above (except Illinois) and smaller portions of New York, Tennessee, Alabama, Illinois, Pennsylvania, Virginia, and North Carolina.

This watershed is in general characterized in the eastern part by rugged, hilly country, with comparatively small flood plains and level areas. But in the lower and western portion the general ruggedness gives way to comparatively large stretches of rolling or nearly level areas along the less rapid main stream or its larger tributaries, notably the Wabash.

The geographical position of the main stream is such that tributaries of the upper portion are subject to rather rigorous winter conditions, with the result that spring thaws produce high floods, which erode the banks and scour the channels of tributaries and of the main stream and carry very large amounts of suspended matter and silt downstream. Fluctuations of level and consequent erosion in the upper portions are further induced by the general ruggedness of the watershed and the relatively steep slopes of the channels. On the other hand, such tributaries as the Cumberland and the Tennessee Rivers, coming from the south and joining the Ohio in the less rugged lower portion, are not subject to such extremes of temperature and level.

The channel of the main stream is characterized by numerous islands, bars, wide shallow riffles, and a few deep pools. Hills noted for their beauty adorn either bank. Flood plains are few and comparatively small in size. There are no extensive back-water areas, with the result that there is little opportunity for flood water to be retarded by temporary overflow on such lowlands. These natural checks of turbulent, destructive floods are practically absent in the upper two-thirds of the Ohio channel, and are but few even in the lower portions.

These natural conditions are modified somewhat by the numerous dams that have been constructed along the river. These now number 38, and more are being built. Most of them are of the "beartrap" type, so constructed that they may be laid down, allowing the water to flow over their sills without obstruction; or at low stages they may be raised, forming pools of sufficient depth for river transportation purposes. Ultimately, by the aid of these dams, the river will be navigable from mouth to the source at Pittsburgh, and the series of pools thus formed will profoundly affect the biology of the stream.

The main sources of direct sewage pollution of the Ohio River are the metropolitan districts of Pittsburgh, Cincinnati, and Louisville. Relatively small amounts of polluting matter, chiefly sewage, are contributed by Wheeling, Huntington, Portsmouth, Evansville, and Paducah. Certain tributaries whose well-populated valleys find convenient disposal of their sewage in the local stream tend to increase by a small margin the load already carried by the main stream. This is true of the Beaver River, also of the Scioto. The majority of the tributaries, however, tend to dilute, rather then to concentrate, the sewage content of the Ohio.

The initial pollution at Pittsburgh consists essentially of the untreated sewage from a population of 1,000,000, in round numbers, together with a large amount of industrial wastes, details of which will be given elsewhere in the complete Ohio report. The second heavy pollution occurs at Cincinnati, where the river receives the untreated sewage from more than half a million population. However, in the 480-mile flow from Pittsburgh the stream has largely recovered from the initial pollution and has been augmented by tributaries until the volume of water at Cincinnati is more than four times that at Pittsburgh. Similarly, at Louisville the pollution incident to a population of 300,000 is received by the stream which, after a flow of 120 miles from Cincinnati, has been increased measurably by the advent of the relatively clean Miami and Kentucky Rivers, thus increasing, rather than diminishing, its capacity for the disposal of the organic matter received at Louisville.

THE PITTSBURGH DISTRICT.

In brief, certain of the factors that may affect the biological situation at Pittsburgh are:

Two streams, the Allegheny from the north and the Monongahela from the south, with unequal volumes of dissimilar waters, unite to form the Ohio.

The Allegheny, contributing 60 per cent of the water, is characterized by severe winter conditions, a quick-spilling basin, steep and uniform slope, widely scattered population and points of pollution, and a short time-factor for biological action in the 24-mile slack-water basin formed by three dams just above Pittsburgh. The water is alkaline and usually turbid.

The Monongahela, contributing 40 per cent, has comparatively mild winter conditions. Floods from the quick-spilling basin are checked by the 131-mile slack-water stretch formed by continuous dams, which thus insure a long time-factor for sedimentation and biological reduction of sewage and waste from a large and concentrated population and from industrial establishments lining the river

and Wabash Rivers; tributaries from the south are Kanawha, Licking, Kentucky, Green, Cumberland, and Tennessee Rivers.

The total area of the watershed drained by the Ohio and its tributaries is 203,000 square miles and constitutes the major portions of the States named above (except Illinois) and smaller portions of New York, Tennessee, Alabama, Illinois, Pennsylvania, Virginia, and North Carolina.

This watershed is in general characterized in the eastern part by rugged, hilly country, with comparatively small flood plains and level areas. But in the lower and western portion the general ruggedness gives way to comparatively large stretches of rolling or nearly level areas along the less rapid main stream or its larger tributaries, notably the Wabash.

The geographical position of the main stream is such that tributaries of the upper portion are subject to rather rigorous winter conditions, with the result that spring thaws produce high floods, which erode the banks and scour the channels of tributaries and of the main stream and carry very large amounts of suspended matter and silt downstream. Fluctuations of level and consequent erosion in the upper portions are further induced by the general ruggedness of the watershed and the relatively steep slopes of the channels. On the other hand, such tributaries as the Cumberland and the Tennessee Rivers, coming from the south and joining the Ohio in the less rugged lower portion, are not subject to such extremes of temperature and level.

The channel of the main stream is characterized by numerous islands, bars, wide shallow riffles, and a few deep pools. Hills noted for their beauty adorn either bank. Flood plains are few and comparatively small in size. There are no extensive back-water areas, with the result that there is little opportunity for flood water to be retarded by temporary overflow on such lowlands. These natural checks of turbulent, destructive floods are practically absent in the upper two-thirds of the Ohio channel, and are but few even in the lower portions.

These natural conditions are modified somewhat by the numerous dams that have been constructed along the river. These now number 38, and more are being built. Most of them are of the "beartrap" type, so constructed that they may be laid down, allowing the water to flow over their sills without obstruction; or at low stages they may be raised, forming pools of sufficient depth for river transportation purposes. Ultimately, by the aid of these dams, the river will be navigable from mouth to the source at Pittsburgh, and the series of pools thus formed will profoundly affect the biology of the stream.

mines. But it has also enjoyed the great advantage of a long time-factor. Except for one item, this combination of factors would, in all likelihood, insure great productiveness and activity among the plankton organisms, for food is abundant and the impounded water gives ample time and quiet for reproduction. The factor whose effect is not definitely known is the mine drainage and the pickling wastes from steel mills, which tend to make the water acid in reaction. The bacterial content of the water is very low and out of all proportion to the large amounts of pollution entering the river. It is extremely probable that any substance thus toxic to bacteria would to an appreciable extent affect the plankton forms also.

Further data, and laboratory experiment as well, are necessary before it may be said in just what manner this unfavorable environment affects the smaller organisms of the plankton. The effect may be direct, especially to plantlike organisms, resulting in the more or less speedy death of these minute forms when the water in which they have been reared is presently mingled with that in the lower part of the slack-water basin where the reaction is prevailingly acid. Or the effect may be exerted indirectly by the killing off of the bacteria which form a large part of the food supply of many of those plankton organisms which ingest food particles rather than absorb dissolved material as do plants. Regardless of the acidity of the water, these organisms could not be present in numbers when their chief food supply is not to be found. It has been observed repeatedly (Kofoid, 1904, pp. 116, 117, 120) that such forms as those mentioned above disappear from the water when a considerable degree of purification is indicated by the diminishing numbers of bacteria. There is a vital relationship of some kind existing between them.

Plankton is abundant at M–12, however, but it is limited to a very few organisms. Rotifers constitute 89 to 96 per cent of all organisms found, and these rotifers are of two kinds only.

It seems reasonable to assume that these narrow limits as to variety of organisms which comprise the plankton are the result of some unfavorable influence which eliminates all forms except these few varieties.

The question of food supply for some of these organisms is a matter of interest. The most abundant rotifer, *Brachionus*, is herbivorous, or, at any rate, omnivorous, in common with most of the ploiman rotifers (Kofoid, 1904, p. 145), and is thought to find most of its food in phytoplankton, that is, minute chlorophyll-bearing organisms. But these minute organisms were not found at all in the samples. It is possible that the difficulties of recognizing them in the preserved catch might account in part for this result, but such human limitations would not give wholly negative results in every sample examined.

It seems probable that these rotifers would find their chief food supply in the abundant organic matter in suspension in the water incident to heavy sewage pollution and incident, further, to the absence of sufficient bacterial life to dispose of this material.

We thus see at M-12 the unusual spectacle of a plankton which has responded to the very favorable conditions of environment, abundant food, and very long time-factor, but which has meantime been subject to some biological catastrophe which has nearly or quite eliminated the first few links in the chain of organisms whose interdependence arises from their food relations. The resulting plankton is large, but consists of a very small variety of the larger organisms—the biological end-product of the complicated reactions due to the dominant factors of abundant food, long storage, and, probably, acidity of water at this station.

Station A-7.—In the Allegheny at Station A-7 during the same period the temperature ranged from 24° C. to 16° C., turbidity from practically zero to 60, and river levels recorded by the gauge at Freeport, Pa., fluctuated from 0.7 to 2.2. The monthly average plankton content varied from 0.2 to 1 per cent of total catch.

Rhizopods held leading place in September and diatoms in October Noticeable features of plankton were variety of organisms present, unusual scarcity of organisms in August samples, and relatively small plankton yield at all times.

The water is of comparatively recent origin owing to the gradual and considerable slope of 2 feet per mile in the lower 85 miles of this river and owing, further, to the absence of any slack-water basin that is sufficient in size to impound the large discharge of this stream for more than a short period. The river is thus very sensitive to flood conditions, and consequently the short slack-water stretch just above Pittsburgh is subject to quite frequent renewals of the water. This condition is disastrous to plankton life generally (Kofoid, 1903, p. 458) by preventing that adequate decay of sewage which would furnish plankton life with abundant food and, further, by providing a time-factor which is far too short for the breeding of plankton in quantity. The partially decayed organic material, together with such plankton as may be present, are swept on into the Ohio by the frequent floods.

Conditions similar to the foregoing were found in the study of the Illinois River by Kofoid (1903, pp. 349, 458). The plankton production of a certain tributary (Spoon River) averaged only one-fiftieth that of the main stream, and the only available explanation was found in the fact that the water of the tributary was of recent origin and the relatively rapid current caused such frequent renewal of the water that there was insufficient time for the breeding of plankton in this tributary stream. Kofoid concluded: " *The age of* *the water* is, other things being equal, one of the most vital of all the hydrographic factors environing the plankton."

The organisms found in samples at Station A–7 apparently reflect the varied and somewhat unstable conditions of environment.

For some reason not apparent, August samples yielded very few organisms. Turbidity had reached a maximum of 90 the day preceding our first collection, although the gauge at Freeport showed a rise in levels of only 2 feet. It is possible that this influx of turbid water, probably from some tributary, reacted unfavorably on August plankton.

September samples reflected the moderate disturbance of river levels by showing predominance of the rhizopods *Difflugia* and *Arcella,* both of these organisms belonging normally to bottom sediments or to the surface of decaying plants or other organic matter. Their prominence in plankton samples is usually a function of disturbed conditions of stream flow. Holophytic (plantlike) organisms are moderately abundant as a result of comparatively low turbidity, premitting access of sunlight. In turn, the rotifer *Anuræa,* which feeds principally on minute plant life, is present in small numbers. *Anthophysa,* a colorless flagellate, usually abundant in contaminated water, is present also.

Cooler temperatures in October favor the growth of diatoms, which are found moderately abundant. A rise in water levels brought the bottom-loving organisms *Difflugia* and *Arcella* again into the plankton in the last sample, together with a large amount of suspended matter.

Station O–3.—Ten weekly samples taken at O–3 during this period of very moderate fluctuation as to temperature and turbidity show a monthly average plankton content of 7.6 to 8 per cent of the total catch.

Organisms present show moderate variety, rotifers predominating, comprising 91, 66, and 61 per cent of all the plankton forms in the three months, taken in order. Ciliates appear in moderate numbers. Crustacea and diatoms are present in small numbers. Neither diatoms nor algæ appear in August, both are found in September, and algæ again in October.

Hydrographic conditions were so nearly uniform and stable that the plankton catches may be regarded as truly representative of prevailing low-water conditions at this station—the first in the Ohio River proper.

Abundance of plankton in all catches means that suitable food for these organisms is plentiful. This necessity is evidently supplied partly from the two tributary streams that unite to form the Ohio River and partly from the great volume of sewage and industrial banks. The water is generally acid from mine drainage and but slightly turbid.

A slack-water basin extending nearly 5 miles below Pittsburgh (except during high water) receives these two tributaries, together with large amounts of untreated sewage and industrial wastes discharged directly into this basin along Pittsburgh's total water frontage of 31½ miles.

Finally, abundance of organic material in various stages of decomposition, restored alkaline reaction, and a considerable time element constitute a favorable environment for biological action at this point.

Samples were taken from each of the two rivers at points some distance above the point of confluence and above the portion of the Pittsburgh water front where sewage and wastes are added to the river. The sampling point for the Allegheny River is 7 miles upstream from the confluence of the two streams, and is designated by A–7. The Monongahela sampling point is 12 miles above the confluence and its designation is M–12. At O–3, 3 miles below the confluence, samples were taken to ascertain the content of the mixed waters. Similarly, O–23 designates a sampling point sufficiently far below Pittsburgh to insure thorough mixture, as well as a considerable time interval for biological action and sedimentation, through the agency of five successive pools formed by as many dams. Samples were also taken in the mouth of the Beaver River, which enters the Ohio 25 miles below Pittsburgh.

Water from these five sampling points show the biological condition of the streams on reaching the Pittsburgh district, but before the access of sewage and wastes from the city itself; after the two tributaries combine and have meantime received sewage and industrial wastes in large amount from Pittsburgh; after the complete mixing, sedimentation, and detention caused by the five dams; and at the mouth of the Beaver River.

The average results of weekly examinations made during the months of August, September, and October, 1914, are given in Table No. 6 (p. 53) and the principal features are shown graphically in planktograph No. 1 (p. 58).

Station M–12.—Ten weekly samples taken at M–12 during a period of relatively stable conditions of temperature, river stage, and turbidity showed a relatively constant content of organisms, both as to amount and kind. Organisms averaged 5.3 to 6.4 per cent of catch (monthly averages). Rotifers constituted 89 to 96 per cent of all organisms present. Lack of variety and total absence of green algæ further characterized the plankton.

This sampling point, located near the lower end of the 131-mile slack-water stretch, represents water which has been subject to heavy pollution by sewage, by industrial wastes, and by drainage from coal

doubtedly show a biological reflection in a decreased plankton production.

The plankton-poor water of the Allegheny will function as a diluent of the more abundant plankton contributed by the Monongahela. Inasmuch as the usual discharge of the Allegheny is considerably in excess of that from the other tributary, it is no surprise that the plankton at O–3 reflects this diminished relative value and, to some extent, shows something of the variety of organisms which characterizes the scanty plankton contributed by the larger stream.

Abundance of organic matter is indicated at O–3 by the prevalence of the same rotifers, *Brachionus* and *Rotifer vulgarus*, which we find predominant at M–12. Distinctly pollutional organisms, *Anthophysa* of the Mastigophora and *Vorticella* and *Epistylis* of the Ciliata, appeared in five samples. *Vorticella* formed 29 per cent of the entire catch in one of these samples and from 1 to 9 per cent in three other samples. *Rotifer actinurus*, a pollutional organism (Forbes and Richardson, 1913, pp. 502, 513), appeared in moderate abundance in 1 sample, while in 7 of 10 samples the contaminate *Rotifer vulgaris* was abundant.

Station O–23.—At Station O–23, 10 weekly samples taken during a period of relative quiet as to water conditions show a moderate assortment of organisms. Rotifers predominate in two months and crustacea in one. Diatoms are abundant in one August sample Green algæ, Mastigophora, and ciliates are present in rather small numbers. A noticeable feature of collections here is the decline of rotifers as the leading plankton and the gradual advent of crustacea.

Diatoms (*Synedra delicatissima*) are abundant in one sample only, that of August 25. Temperature was 24° C. The sudden appearance of this organism, which is usually more abundant in cool weather than in warm, seems to be without explanation except for the fact that the "bear traps" had been lowered a few days before and the pools were drained of some of their surface water. This disturbance and readjustment of levels might be responsible for the appearance at this station of the relatively large number of diatoms whose growth and multiplication had probably taken place in some sheltered bit of water in one of the upstream dams. It is worth noting, also, that an unusual number of *Brachionus* (the same rotifer that is so abundant at O–3 and at M–12) appeared in this same August sample at O–23. The lowering of the "bear traps" was reported August 18, one week before this sample was taken.

The list of organisms, together with relative abundance of certain kinds, indicates some improvement in the water. Two organisms of recognized pollutional affinities, *Euglena viridis* and one of the *Vorticellidæ*, were present in moderate amount in one sample, and a very few of the former organism in a second sample. However, the presence of *Brachionus* in 5 of the 10 samples would indicate sufficient organic matter to furnish food to this rotifer, which is classed by some writers as a contaminate organism. (Eyferth, 1909, p. 531.) On the other hand, the better condition of the water is attested by the fact that the pollutional rotifers *R. actinurus* and *R. vulgaris*, which were fairly abundant at O–3, are entirely absent here: the pollutional protozoa *Anthophysa* and *Epistylis* are likewise absent. Moreover, a rotifer of recognized cleaner water environment, *Anuræa* (Kofoid, 1904, p. 151), is here found in four samples, while it was entirely absent at O–3. The minute algæ which constitute much of the food of this rotifer is present at both O–3 and O–23.

Perhaps the most notable feature of plankton at this station lies in the fact that, while rotifers hold first place quantitatively in August and September, the crustacea (*Cyclops*) assume this rôle in October and maintain it, as far as rotifers are concerned, in plankton collections farther down the river at Wheeling. In food habits *Cyclops* is a scavenger (Herrick, 1884), and its presence means the destruction of much of the organic matter that has thus far escaped or survived the attacks of bacteria, ciliates, and certain rotifers.

This station is in the lower part of pool formed by Dam No. 5, hence, between the last station considered, O–3, and this point intervenes a stretch of 20 miles of water, all of which is impounded by Dams Nos. 1 to 5, inclusive. According to data given in the hydrometric section of the full report,[1] the time of flow between these two stations was 5.59 days in August, 6.20 in September, and 12.49 days in October 1–15. It will thus be seen that the time interval concerned is out of all proportion to the distance traversed. That this very slow movement of water provides sufficient time interval for considerable biological activity would seem to be demonstrated by the fact that the plankton at O–23 is reduced in net amount and changed in regard to the predominating organisms.

Beaver River.—Samples from the Beaver River show a varying and rather abundant plankton made up of a well-balanced variety of forms and contributing from 4 to 13 per cent of the total catch.

Diatoms appear in every catch and are relatively abundant in eight catches, forming from 17 to 86 per cent of all organisms in the respective catches, the larger values being confined, with one exception, to the cooler temperatures of the last four weeks, September 15 to October 15. *Synedra delicatissima* was most abundant, appearing in every sample but one and forming the bulk of the entire catch in the last four samples, seemingly favored by the cooler weather. *S. biceps* and *S. ulna*, the latter classed by Senft (1905) as a pollutional organism, were present in moderate numbers in nearly all samples.

---

[1] Not yet published.

Minute green algæ, consisting of fragments of very small filamentous forms together with the unicellular *Pediastrum* and *Scenedesmus*, formed from 2 to 27 per cent of organisms in nearly all the catches. Small amounts of blue-greens were found in four samples. Chlorophyll-bearing flagellates of the Mastigophora, chiefly *Euglena viridis*, *Dinobryon*, and *Phacus*, were present in similar amounts. The diatoms, algæ, and green flagellates thus aggregate a volume of synthetic or plantlike organisms which is somewhat greater than the volume of plankton animals, as will be seen.

Of the plankton animals, *Difflugia*, a bottom rhizopod, was present in two samples, one of which was taken during rising levels and the other following the crest of a rise. Ciliates were represented by *Codonella* and *Tintinnus*, sparingly found in two samples. This scarcity of ciliates, which are usually abundant in contaminated water, is surprising, in consideration of the fact that the presence of pollution is indicated by *Euglena viridis* in a majority of the samples, and a similar organism, *Phacus*, is found in four samples.

Three samples contain the rotifer *Brachionus* in small to moderate numbers, and the contaminate rotifer *R. vulgaris* was found in two samples, but in small numbers. The rotifer *Anuræa cochlearis*, which is not characteristic of great pollution but abounds in water containing only moderate amounts of organic matter, was moderately abundant in 8 of the 10 samples. It is noticeable also that the minute chlorophyll-bearing organisms that form the greatest part of the food of this rotifer (Kofoid, 1904, p. 151) were found in all samples but one.

Crustacea appeared sparingly in two samples only. *Cyclops*, the leading form, thrives best in a stable environment as to water movement. (Kofoid, 1904, pp. 260, 267.) The mild but frequent fluctuations of the Beaver River during this period may explain, in part at least, the scarcity of crustacea. These disturbances of water levels will also explain the presence in four samples of a few nematode worms which normally live in bottom ooze or in decaying matter which would be disturbed by fluctuating movements of water.

The relatively heavy plankton of the Beaver River, averaging 4 to 13 per cent of the average total catch, indicates that conditions are, on the whole, favorable for plankton production. The one unfavorable condition thus far observed is found in the somewhat unstable hydrographic conditions. The fact that this does not seem to interfere with the presence of relatively abundant plankton would seem to indicate that other vital factors of plankton production are at their best, thus compensating in some degree for the unfavorable condition mentioned. It is therefore evident that food, in all probability sewage, is present in considerable amount, and in such stages

and Wabash Rivers; tributaries from the south are Kanawha, Licking, Kentucky, Green, Cumberland, and Tennessee Rivers.

The total area of the watershed drained by the Ohio and its tributaries is 203,000 square miles and constitutes the major portions of the States named above (except Illinois) and smaller portions of New York, Tennessee, Alabama, Illinois, Pennsylvania, Virginia, and North Carolina.

This watershed is in general characterized in the eastern part by rugged, hilly country, with comparatively small flood plains and level areas. But in the lower and western portion the general ruggedness gives way to comparatively large stretches of rolling or nearly level areas along the less rapid main stream or its larger tributaries, notably the Wabash.

The geographical position of the main stream is such that tributaries of the upper portion are subject to rather rigorous winter conditions, with the result that spring thaws produce high floods, which erode the banks and scour the channels of tributaries and of the main stream and carry very large amounts of suspended matter and silt downstream. Fluctuations of level and consequent erosion in the upper portions are further induced by the general ruggedness of the watershed and the relatively steep slopes of the channels. On the other hand, such tributaries as the Cumberland and the Tennessee Rivers, coming from the south and joining the Ohio in the less rugged lower portion, are not subject to such extremes of temperature and level.

The channel of the main stream is characterized by numerous islands, bars, wide shallow riffles, and a few deep pools. Hills noted for their beauty adorn either bank. Flood plains are few and comparatively small in size. There are no extensive back-water areas, with the result that there is little opportunity for flood water to be retarded by temporary overflow on such lowlands. These natural checks of turbulent, destructive floods are practically absent in the upper two-thirds of the Ohio channel, and are but few even in the lower portions.

These natural conditions are modified somewhat by the numerous dams that have been constructed along the river. These now number 38, and more are being built. Most of them are of the "bear-trap" type, so constructed that they may be laid down, allowing the water to flow over their sills without obstruction; or at low stages they may be raised, forming pools of sufficient depth for river transportation purposes. Ultimately, by the aid of these dams, the river will be navigable from mouth to the source at Pittsburgh, and the series of pools thus formed will profoundly affect the biology of the stream.

The main sources of direct sewage pollution of the Ohio River are the metropolitan districts of Pittsburgh, Cincinnati, and Louisville. Relatively small amounts of polluting matter, chiefly sewage, are contributed by Wheeling, Huntington, Portsmouth, Evansville, and Paducah. Certain tributaries whose well-populated valleys find convenient disposal of their sewage in the local stream tend to increase by a small margin the load already carried by the main stream. This is true of the Beaver River, also of the Scioto. The majority of the tributaries, however, tend to dilute, rather then to concentrate, the sewage content of the Ohio.

The initial pollution at Pittsburgh consists essentially of the untreated sewage from a population of 1,000,000, in round numbers, together with a large amount of industrial wastes, details of which will be given elsewhere in the complete Ohio report. The second heavy pollution occurs at Cincinnati, where the river receives the untreated sewage from more than half a million population. However, in the 480-mile flow from Pittsburgh the stream has largely recovered from the initial pollution and has been augmented by tributaries until the volume of water at Cincinnati is more than four times that at Pittsburgh. Similarly, at Louisville the pollution incident to a population of 300,000 is received by the stream which, after a flow of 120 miles from Cincinnati, has been increased measurably by the advent of the relatively clean Miami and Kentucky Rivers, thus increasing, rather than diminishing, its capacity for the disposal of the organic matter received at Louisville.

THE PITTSBURGH DISTRICT.

In brief, certain of the factors that may affect the biological situation at Pittsburgh are:

Two streams, the Allegheny from the north and the Monongahela from the south, with unequal volumes of dissimilar waters, unite to form the Ohio.

The Allegheny, contributing 60 per cent of the water, is characterized by severe winter conditions, a quick-spilling basin, steep and uniform slope, widely scattered population and points of pollution, and a short time-factor for biological action in the 24-mile slack-water basin formed by three dams just above Pittsburgh. The water is alkaline and usually turbid.

The Monongahela, contributing 40 per cent, has comparatively mild winter conditions. Floods from the quick-spilling basin are checked by the 131-mile slack-water stretch formed by continuous dams, which thus insure a long time-factor for sedimentation and biological reduction of sewage and waste from a large and concentrated population and from industrial establishments lining the river ence of *Brachionus* in 5 of the 10 samples would indicate sufficient organic matter to furnish food to this rotifer, which is classed by some writers as a contaminate organism. (Eyferth, 1909, p. 534.) On the other hand, the better condition of the water is attested by the fact that the pollutional rotifers *R. actinurus* and *R. vulgaris*, which were fairly abundant at O–3, are entirely absent here; the pollutional protozoa *Anthophysa* and *Epistylis* are likewise absent. Moreover, a rotifer of recognized cleaner water environment, *Anuraea* (Kofoid, 1904, p. 151), is here found in four samples, while it was entirely absent at O–3. The minute algæ which constitute much of the food of this rotifer is present at both O–3 and O–23.

Perhaps the most notable feature of plankton at this station lies in the fact that, while rotifers hold first place quantitatively in August and September, the crustacea (*Cyclops*) assume this rôle in October and maintain it, as far as rotifers are concerned, in plankton collections farther down the river at Wheeling. In food habits *Cyclops* is a scavenger (Herrick, 1884), and its presence means the destruction of much of the organic matter that has thus far escaped or survived the attacks of bacteria, ciliates, and certain rotifers.

This station is in the lower part of pool formed by Dam No. 5, hence, between the last station considered, O–3, and this point intervenes a stretch of 20 miles of water, all of which is impounded by Dams Nos. 1 to 5, inclusive. According to data given in the hydrometric section of the full report,[1] the time of flow between these two stations was 5.59 days in August, 6.20 in September, and 12.49 days in October 1–15. It will thus be seen that the time interval concerned is out of all proportion to the distance traversed. That this very slow movement of water provides sufficient time interval for considerable biological activity would seem to be demonstrated by the fact that the plankton at O–23 is reduced in net amount and changed in regard to the predominating organisms.

Beaver River.—Samples from the Beaver River show a varying and rather abundant plankton made up of a well-balanced variety of forms and contributing from 4 to 13 per cent of the total catch.

Diatoms appear in every catch and are relatively abundant in eight catches, forming from 17 to 86 per cent of all organisms in the respective catches, the larger values being confined, with one exception, to the cooler temperatures of the last four weeks, September 15 to October 15. *Synedra delicatissima* was most abundant, appearing in every sample but one and forming the bulk of the entire catch in the last four samples, seemingly favored by the cooler weather. *S. biceps* and *S. ulna*, the latter classed by Senft (1905) as a pollutional organism, were present in moderate numbers in nearly all samples.

---

[1] Not yet published.

Minute green algæ, consisting of fragments of very small filamenous forms together with the unicellular *Pediastrum* and *Scenedesmus*, ormed from 2 to 27 per cent of organisms in nearly all the catches. Small amounts of blue-greens were found in four samples. Chlorophyll-bearing flagellates of the Mastigophora, chiefly *Euglena viridis*, *Dinobryon*, and *Phacus*, were present in similar amounts. The diaoms, algæ, and green flagellates thus aggregate a volume of synthetic or plantlike organisms which is somewhat greater than the volume of plankton animals, as will be seen.

Of the plankton animals, *Difflugia*, a bottom rhizopod, was present in two samples, one of which was taken during rising levels and the other following the crest of a rise. Ciliates were represented by *Codonella* and *Tintinnus*, sparingly found in two samples. This scarcity of ciliates, which are usually abundant in contaminated water, is surprising, in consideration of the fact that the presence of pollution is indicated by *Euglena viridis* in a majority of the samples, and a similar organism, *Phacus*, is found in four samples.

Three samples contain the rotifer *Brachionus* in small to moderate numbers, and the contaminate rotifer *R. vulgaris* was found in two samples, but in small numbers. The rotifer *Anuræa cochlearis*, which is not characteristic of great pollution but abounds in water containing only moderate amounts of organic matter, was moderately abundant in 8 of the 10 samples. It is noticeable also that the minute chlorophyll-bearing organisms that form the greatest part of the food of this rotifer (Kofoid, 1904, p. 151) were found in all samples but one.

Crustacea appeared sparingly in two samples only. *Cyclops*, the leading form, thrives best in a stable environment as to water movement. (Kofoid, 1904, pp. 260, 267.) The mild but frequent fluctuations of the Beaver River during this period may explain, in part at least, the scarcity of crustacea. These disturbances of water levels will also explain the presence in four samples of a few nematode worms which normally live in bottom ooze or in decaying matter which would be disturbed by fluctuating movements of water.

The relatively heavy plankton of the Beaver River, averaging 4 to 13 per cent of the average total catch, indicates that conditions are, on the whole, favorable for plankton production. The one unfavorable condition thus far observed is found in the somewhat unstable hydrographic conditions. The fact that this does not seem to interfere with the presence of relatively abundant plankton would seem to indicate that other vital factors of plankton production are at their best, thus compensating in some degree for the unfavorable condition mentioned. It is therefore evident that food, in all probability sewage, is present in considerable amount, and in such stages

of decomposition as will best suit the requirements of such organisms as constitute the plankton. Toxic conditions, such as the acidity of water, which apparently limits to a few resistant organisms the plankton of the Monogahela River, are evidently absent from the Beaver River, for a large variety of organisms is included in the list of plankton.

Bottom deposits.—In addition to the samples of water taken for examination, a series of 20 samples of bottom mud was collected for the study of the life upon the bottom of the stream. The samples represented four of the five stations of this district, it having been impossible to obtain any mud at the bottom at Station O–23.

The tubificid worm, *Limnodrilus*, characteristic of sewage pollution, was found at each of the stations, but in increasing numbers with increasing pollution. It was comparatively rare in the Monongahela, and present in great abundance at Station O–3.

Some *Chironomus* larvæ and the associated form *Tanypus* were found occasionally.

In general, results are what might be expected from the known facts concerning the condition of pollution of the waters. The unfavorable effect of acidity is also observed, although here again it can not be stated whether this effect is primary or secondary.

SUMMARY OF BIOLOGICAL CONDITIONS IN THE PITTSBURGH DISTRICT.

The nearly equal urban and sewered populations of the two contributing watersheds tend to produce waters that, without consideration of other factors, upon their arrival at Pittsburgh are similarly contaminated. But the great variation of climatic, physical, and other factors make of the two streams distinctly different biological habitats. Prominent among these differences are geographical position, size of catchment area, slope of valley, detention of water by pools and dams, amount and kind of industrial wastes and mine drainage, and, finally, the distribution of population with reference to the time of flow from the points of pollution to the confluence at Pittsburgh.

The average yield of plankton in the lower Monongahela is considerably greater than that of the lower Allegheny. This condition is ascribed to the long storage period to which the Monongahela water is subjected, and the resulting age of the water, permitting extensive development of plankton life in the nearly motionless waters rich in the accumulated products of decay of organic matter.

But this heavy plankton is limited to a small assortment of organisms, presumably because the acid condition of the water kills off the smaller ones and the less resistant of the larger forms, both plant and animal, leaving to few surviving varieties the very large

supply of rich food that must be present in this old and heavily polluted water. The possibility of an acquired immunity having resulted from continuous exposure of successive generations to the acidity of the water is an interesting biological contingency.

The smaller plankton yield of the Allegheny seems to be due chiefly to water movement and consequent frequent replacement of water by that of more recent origin, thus cutting short the time period required for plankton production and for the requisite degree of decomposition of organic matter which results in suitable food for plankton organisms.

The waters, on combining, are subjected to a further time period of two to four days in reaching Station O–3, receiving in the meantime a large amount of sewage and of various industrial wastes along the Pittsburgh water front. The plankton at this station is not as large as conditions of food supply and time-factor seem to warrant, the discrepancy being due, in all probability, to the presence of harmful substances among the numerous industrial wastes discharged into the river. Before O–23 is reached Dams Nos. 1 to 5 have impounded the water for an additional period of 5½ to 12 days. The resulting plankton at O–23 is reduced in net amount and changed in character.

Organisms at M–12 can hardly be regarded as characteristic of pollution, except one rotifer (*R. vulgaris*), which is so classed by Eyferth (1909) and was found in 7 of the 10 samples.

The small amount of plankton at A–7 exhibits a varied assortment of organisms which do not, as a whole, indicate pollution. One distinctly pollutional organism is relatively abundant in one sample and is present in a second.

In plankton from O–3 distinctly pollutional and contaminate organisms are present in every sample but one.

Plankton from O–23 shows known pollutional organisms in two samples. The presence of the cleaner water rotifer *Anuræa* in four samples, together with the decline of rotifers as a class and the corresponding increase of crustacea, are significant of some improvement in the water since leaving Station O–3.

The Beaver River yields an abundant and well-assorted plankton, in which diatoms predominate. The rotifer *Anuræa* is found in most samples. Pollutional organisms are present in moderate and small numbers in 8 of the 10 samples.

Mud samples give throughout evidence of pollution.

waste contributed along the Pittsburgh water front. It is evident that this organic matter thus supplied from these sources will vary greatly in age and in stage of decomposition; that from the Monongahela having been subject to a very long time period, but in water of acid reaction; that from the Allegheny River representing a variety of ages on account of the widely scattered locations of the towns on its watershed; and, finally, the sewage and waste from Pittsburgh representing a comparatively fresh condition.

It would seem that this organic material of different kinds, of different ages, and hence in various degrees of decomposition, would supply all necessary food requirements for a large and varied assortment of plankton organisms.

The slack-water basin formed by the dam a short distance below this sampling point provides comparatively still water along the entire Pittsburgh water front, thus imposing on the mingled waters forming the Ohio River a moderately long time-factor which would tend to encourage biological activity. This, with the presence of abundant food, should produce a heavier growth of plankton than we find at O–3.

Reference to the chemical data reported in another section will show that during August, September, and October, when our samples were taken, the acidity of the Monongahela had been neutralized by the alkaline water of the Allegheny and the acid salts of the Monongahela had been largely eliminated. There are probably many reactions and adjustments taking place of which we have no direct knowledge. We know only these end reactions or the final outcome.

This beginning of the Ohio River at Pittsburgh is evidently the arena in which the dissimilar waters of the two tributaries settle their differences of chemical reaction and physical condition and acquire the final adjustments which appear in samples taken at O–11, this final outcome being hastened, or variously modified, presumably, by the large amount of industrial wastes and sewage introduced at Pittsburgh.

It seems highly probable that the acidity of the Monongahela might at times be a factor at O–3, for occasional acidity was noted in daily samples at O–11, where chemical samples were taken. This probability is strengthened, moreover, by the fact that during one month of this period (August) the discharge of the Monongahela was 2,070 second-feet and that of the Allegheny was 1,660 second-feet, a reversal of the usual order of relative discharge of these streams.

Any such occasional acidity at O–3 would be likely to exert unfavorable influence on the development of plankton life, as is the case at M–12. Moreover, the various changes in the concentration of dissolved materials (including acid salts) that must be a part of the process of readjustment in this physiochemical arena would un-

backed-up water of Wheeling Creek, which is bubbling and offensive in consequence of the septic action resulting.

Three sampling stations were utilized in the study of the waters of this district. The upper station, O–65, is 40 miles below the mouth of the Beaver and 25 miles above Wheeling; the middle station, O–77, lies between Steubenville and Wheeling; and the lower station, O–97, is at the lower end of the basin formed by Dam No. 13 and about 6 miles below Wheeling, all in slack water at low river stages.

Samples were taken at weekly intervals from each of these stations during August, September, and October, 1914. The hydrographic conditions were unusually stable. The average results of these examinations are recorded in Table No. 1, page 14, and the principal features are shown graphically in planktograph No. 2.

Station O–65.—This station yielded a moderately light plankton containing few pollutional organisms, but with crustacean scavengers rather abundant.

The Beaver River and East Liverpool, 20 miles above this point, constitute the only recent pollution. The Beaver River increases the volume of the Ohio by about 10 per cent and contributes a heavy plankton made up of a varied assortment of organisms. After 40 miles of flow and with these influences at work the station under consideration yields a plankton which differs from that at Station O–23 in being less abundant and in showing better biological balance.

Three dams are located in the stretch between the mouth of Beaver River and Station O–65. The impounding action is accentuated by the low water levels prevailing in the Ohio River during this period.

The hydrometric studies show that the mean time interval between O–23 and O–65 during 1914 was 4.9 days in August, 6.14 days in September, and 11.35 days in the first half of October.

Station O–77.—The important features of the results at Station O–77 as contrasted with those at Station O–65 are the greater abundance of plankton, the increased proportion of crustacea, the higher numbers of diatoms and lower numbers of algæ, and the regular occurrence in small numbers of *Euglena viridis* of recognized pollutional habitat.

The two stations are essentially similar in regard to the organisms that predominate. In both, diatoms lead, except in August at Station O–77, and crustacea are abundant, exceeding the rotifers in total volume.

The relatively large amount of plankton is significant, considering the fact that thus far there has been a successive and consistent decrease as the Stations O–3, O–23, and O–65 are reached. It is indicated, therefore, that the steady decrease in plankton content noted in the upper stations was due to food exhaustion, and that this decrease has been temporarily arrested by the addition of a considerable amount of sewage from Steubenville and Wellsburg.

Station 0-97.—Notwithstanding access of sewage and industrial waste from Wheeling and the slight impounding action of Dam No. 13, plankton at O-97 showed a decrease, instead of an increase, as compared with plankton from O-77.

Differences in the biological balance and in the predominating organisms give somewhat uncertain evidence of the activity of some unfavorable factor which may be responsible for the lack of normal increase in plankton.

Few pollutional organisms are present. Crustacean scavengers are abundant, however. Cleaner water organisms are moderately abundant.

Bottom deposits.—Repeated dredgings at each of the stations of this district failed to bring to the surface anything but clean sand and gravel.

SUMMARY OF BIOLOGICAL CONDITIONS IN THE WHEELING DISTRICT.

At O-65 the relatively light plankton indicates the gradual exhaustion of available food since leaving the last Ohio station at O-23. Thus, despite added pollution from the Beaver River and from East Liverpool, biological purification of the river is well under way at this station, only 65 miles below Pittsburgh. This fact is further shown by the character of the prevailing organisms. Pollutional forms which indicate recent addition of sewage (ciliates and certain flagellates) are few in number, while organisms which are equally characteristic of the presence of old and relatively stable organic matter (diatoms and crustacea) are abundant.

Another matter that speaks well for the betterment of the water is the appearance, for the first time in the Ohio, of biological balance among the plankton organisms. This means a considerable assortment of food materials in various stages of disintegration which permits the existence of a large variety of forms well distributed among holophytic, or plantlike, and holozoic, or animallike, organisms. Biological balance also means absence of any particularly destructive agency, such as toxic material. It means also the presence of such amounts of sunlight, of dissolved gases, and of dissolved salts as may be required for those plantlike organisms which constitute the first links of what Kofoid calls "chains of food relations," the succeeding and final links of which are made up of higher animals.

The Wheeling district as a whole represents the stabilizing of the water as expressed in the prevailing biological balance. As the water leaves this district on its 250-mile trip to the next sampling station it is in more nearly normal and stable condition, judged from a biological point of view, than when it left Station O–23 in the Pittsburgh district.

THE PORTSMOUTH DISTRICT.

Portsmouth is located at the confluence of the Scioto with the Ohio, 355 miles by river below Pittsburgh. Between Wheeling and Portsmouth, a distance of about 265 miles, the Ohio receives comparatively little sewage pollution either directly or through its three tributaries of consequence, the Muskingum, the Kanawha, and the Big Sandy. These three tributaries, together with several smaller ones, increased the volume of water in the Ohio by about 167 per cent between Wheeling and Portsmouth during the period covered by these examinations.

At Portsmouth the Ohio receives the sewage of the city (which is insignificant in proportion to the discharge of the river) and also the waters of the Scioto, draining 6,500 miles and bringing sewage from Columbus, Marion, Circleville, and Chillicothe, aggregating a population of 220,000. Columbus and Chillicothe, the points of chief contamination, are 130 and 60 miles, respectively, above Portsmouth.

The organic matter of the water reaching Portsmouth has undergone the effects of time and dilution afforded by the extended flow from the last station and the advent of large tributaries which add comparatively little pollution.

The movement of water from Wheeling is comparatively rapid in a channel which consists of a succession of islands which divide the current, shoals and riffles which spread the water in a thin sheet, bars which deflect the stream from one side or the other, and pools which retard the movement, a natural mixing arrangement typical of the Ohio River. Two dams controlled by locks also assist somewhat in the impounding and mixing process.

Three stations were selected for the biological studies in this district. Station O–349, 6 miles above the city of Portsmouth, is representative of the water previous to its pollution in noticeable quantities. Station O–358, below the city, gave representative samples of the water after passing the city and as affected by the rather extensive pollution of the Scioto. The Scioto itself was further studied at a station located at its mouth.

The average results of weekly examinations in August, September, and October, 1914, are given in Table 6, and the salient features are shown in graphic form in planktograph No. 3.

Station 349.—Collections at station 349 show large reduction in plankton as compared with the results below Wheeling, evidently due to a gradual exhaustion of the food supply. There is also

waste contributed along the Pittsburgh water front. It is evident that this organic matter thus supplied from these sources will vary greatly in age and in stage of decomposition; that from the Monongahela having been subject to a very long time period, but in water of acid reaction; that from the Allegheny River representing a variety of ages on account of the widely scattered locations of the towns on its watershed; and, finally, the sewage and waste from Pittsburgh representing a comparatively fresh condition.

It would seem that this organic material of different kinds, of different ages, and hence in various degrees of decomposition, would supply all necessary food requirements for a large and varied assortment of plankton organisms.

The slack-water basin formed by the dam a short distance below this sampling point provides comparatively still water along the entire Pittsburgh water front, thus imposing on the mingled waters forming the Ohio River a moderately long time-factor which would tend to encourage biological activity. This, with the presence of abundant food, should produce a heavier growth of plankton than we find at O–3.

Reference to the chemical data reported in another section will show that during August, September, and October, when our samples were taken, the acidity of the Monongahela had been neutralized by the alkaline water of the Allegheny and the acid salts of the Monongahela had been largely eliminated. There are probably many reactions and adjustments taking place of which we have no direct knowledge. We know only these end reactions or the final outcome.

This beginning of the Ohio River at Pittsburgh is evidently the arena in which the dissimilar waters of the two tributaries settle their differences of chemical reaction and physical condition and acquire the final adjustments which appear in samples taken at O–11, this final outcome being hastened, or variously modified, presumably, by the large amount of industrial wastes and sewage introduced at Pittsburgh.

It seems highly probable that the acidity of the Monongahela might at times be a factor at O–3, for occasional acidity was noted in daily samples at O–11, where chemical samples were taken. This probability is strengthened, moreover, by the fact that during one month of this period (August) the discharge of the Monongahela was 2,070 second-feet and that of the Allegheny was 1,660 second-feet, a reversal of the usual order of relative discharge of these streams.

Any such occasional acidity at O–3 would be likely to exert unfavorable influence on the development of plankton life, as is the case at M–12. Moreover, the various changes in the concentration of dissolved materials (including acid salts) that must be a part of the process of readjustment in this physiochemical arena would un-

doubtedly show a biological reflection in a decreased plankton production.

The plankton-poor water of the Allegheny will function as a diluent of the more abundant plankton contributed by the Monongahela. Inasmuch as the usual discharge of the Allegheny is considerably in excess of that from the other tributary, it is no surprise that the plankton at O–3 reflects this diminished relative value and, to some extent, shows something of the variety of organisms which characterizes the scanty plankton contributed by the larger stream.

Abundance of organic matter is indicated at O–3 by the prevalence of the same rotifers, *Brachionus* and *Rotifer vulgarus,* which we find predominant at M–12. Distinctly pollutional organisms, *Anthophysa* of the Mastigophora and *Vorticella* and *Epistylis* of the Ciliata, appeared in five samples. *Vorticella* formed 29 per cent of the entire catch in one of these samples and from 1 to 9 per cent in three other samples. *Rotifer actinurus,* a pollutional organism (Forbes and Richardson, 1913, pp. 502, 513), appeared in moderate abundance in 1 sample, while in 7 of 10 samples the contaminate *Rotifer vulgaris* was abundant.

Station O–23.—At Station O–23, 10 weekly samples taken during a period of relative quiet as to water conditions show a moderate assortment of organisms. Rotifers predominate in two months and crustacea in one. Diatoms are abundant in one August sample Green algæ, Mastigophora, and ciliates are present in rather small numbers. A noticeable feature of collections here is the decline of rotifers as the leading plankton and the gradual advent of crustacea.

Diatoms (*Synedra delicatissima*) are abundant in one sample only, that of August 25. Temperature was 24° C. The sudden appearance of this organism, which is usually more abundant in cool weather than in warm, seems to be without explanation except for the fact that the "bear traps" had been lowered a few days before and the pools were drained of some of their surface water. This disturbance and readjustment of levels might be responsible for the appearance at this station of the relatively large number of diatoms whose growth and multiplication had probably taken place in some sheltered bit of water in one of the upstream dams. It is worth noting, also, that an unusual number of *Brachionus* (the same rotifer that is so abundant at O–3 and at M–12) appeared in this same August sample at O–23. The lowering of the "bear traps" was reported August 18, one week before this sample was taken.

The list of organisms, together with relative abundance of certain kinds, indicates some improvement in the water. Two organisms of recognized pollutional affinities, *Euglena viridis* and one of the *Vorticellidæ,* were present in moderate amount in one sample, and a very few of the former organism in a second sample. However, the pres-

The Little Miami River.—At the mouth of the Little Miami the autumn samples show a light plankton and a marked degree of biological balance, except during high water. Green algæ, diatoms, rotifers, and ciliates are moderately abundant. Pollutional organisms are found in every sample.

Disturbed hydrographic conditions in December, January, and February resulted in light yield of native plankton and several species of adventitious diatoms. Pollutional organisms were present.

March, April, and May record lower turbidity, less disturbance of levels, and rising temperatures. Plankton yield increased steadily. Pollutional organisms appeared in most samples.

The Licking River.—The apparently erratic data from the Licking River constitutes a reflection of the extreme fluctuations of that stream, due largely to the "quick-spilling" type of its drainage basin. The cutting short of the time-factor by hydrographic disturbances, with the consequent interruption of plankton breeding, results in small yield of organisms and of fewer kinds, even when food supply is sufficient. Another aspect of the matter lies in the fact that rapid run-off and disturbances of level are direct causes of high turbidity which shuts out sunlight and prevents the development of those organisms which require light.

Station 475.—A very few diatoms were present. Algæ were slightly more abundant. The heavier organisms, *Difflugia* and *Tintinnus*, were moderately abundant, a condition to be expected when turbidity is high. Nematode worms were abundant in one sample following excessive turbidity. Pollutional organisms were *Anthophysa* in three samples, and small numbers of the rhizopod *Actinophrys* and the flagellate *Euglena* in one sample each.

The year's regimen of the Ohio at station 475 as based on the weekly plankton samples shows stability and low turbidity in the autumn and again in the spring. Fluctuating levels and high turbidity characterized the other seasons. A well-defined seasonal increase of plankton is found in the spring and another in the fall, the latter consisting chiefly of diatoms. Predominance of plantlike organisms during periods of hydrographic stability, and of diatoms during the disturbed hydrographic conditions of winter months, and an abundance of animals, especially the bottom forms, during times of high water and of marked turbidity, are also noted.

Pollutional organisms were present in a large majority (82 per cent) of all of the samples, most of these containing two or more forms of recognized pollutional animals or plants.

The results at station 492 are characterized chiefly by the marked increase in plankton yield during the fall over the yield at station 475. Few pollutional organisms are present during this period of quiet levels. Biological balance is in evidence. The very heavy plankton

RESULTS OF BIOLOGICAL INVESTIGATIONS.

In presenting the result of the biological studies of certain portions of the Ohio and its tributaries it is deemed advisable to set down in the same place a summary of those physical, chemical, and biological characteristics of the stream that may be supposed to determine or be influenced by the presence of the microscopic plant and animal life under investigation.

These various characteristics have been studied in detail and are described more fully in the separate report upon hydrometric, chemical, and bacteriological studies of the river. An effort to summarize the essential factors, giving to each its due weight, and thus to arrive at some reasonable conclusions as to the general biological situation at any given station, is a task attended by perplexing problems and real difficulties. Aquatic life responds to changes in its environment. If this environment be made up of many and diverse factors, the resulting biological situation is correspondingly complex. As stated by Kofoid (1904, p. 41), the organisms in a stream constitute "the biological expression of the state of tension among these various factors which for the moment exists," the factors referred to being a most complex series "whose number and relative potency are subject to constant change and readjustment in the unstable environment of the stream."

It will not be attempted, therefore, to analyze the environmental conditions in terms of biological activity, but rather to set down side by side a summary of the river characteristics and of the biological findings at each station in order that the way may be partially prepared for a study of whatever correlations may exist between the two. That such correlations do exist may be anticipated from general biological principles; and certain marked tendencies are plainly apparent in the data that will be presented in the following pages. It is only by the painstaking collecting, recording, and analyzing of a large amount of observational data of this sort that it will be possible to arrive at a state of knowledge of the ecology of microscopic life comparable with the similar knowledge which now exists in the case of the better-known higher plants and animals.

THE OHIO RIVER.

The Ohio River, formed in southwestern Pennsylvania by the confluence of the Allegheny and Monongahela Rivers, flows in a general southwesterly direction and empties into the Mississippi near the present city of Cairo. Its total length of 967 miles forms the dividing line between the States of Ohio, Indiana, and Illinois on the north and Kentucky and West Virginia on the south. The chief tributaries from the north are the Beaver, Muskingum, Scioto, Miami, In discussing "Food consumers" Marsson speaks of the consumption of bacteria by larger organisms, chiefly ciliates, and says:

> These relatively large unicellular organisms thus dominate over the other living organisms in their vicinity, according to their size, like a cannibal among fish. Many of the metazoa, including the Rotatoria, are likewise bacteria eaters and obtain their food in the same manner as the ciliates. Besides bacteria, this food material embraces other bacteria eaters, diatoms, small algæ, etc. If many bacteria eaters are found in a water, it can safely be inferred that many bacteria are present, hence also a quantity of putrefying substances. * * *

Referring to the effect on plankton of organic matter such as sewage, he says:

> It may also be said that the greater the quantity of impurities reaching a stream, the stronger will be the development of the plankton and the greater the amount of work it will have to perform by means of its nutrition and growth.

Eyferth (1900) describes many hundreds of aquatic organisms, both plants and animals, and ranging from bacteria to rotifers. He gives particular attention to the conditions of environment as shown by the preferred habitat of the various organisms, and, as far as known facts permit, states the attitude of each organism toward pollution, using the terms polysaprobic, mesosaprobic, and oligosaprobic, as suggested by Kolkwitz. Senft (1905) similarly regards many of the aquatic organisms as "living reagents" on account of their observed behavior toward pollution, and classifies them accordingly, using the terms of Kolkwitz.

Various other workers, both American and European, have commented on the observed behavior of aquatic organisms toward organic matter, and have regarded this microscopic life as a factor in the self-purification of surface waters. It seems probable that in the study of aquatic organisms we have a source of evidence relative to the true mechanism of self-purification of streams which is sufficiently important to command a respectful hearing along with the better-known evidence obtained meantime from bacteriological study and chemical examination. Referring to the advantage of maintaining a normal distribution of plant and animal life in a polluted stream to the end that organic matter in water may be most effectively disposed of, Whipple (1914, p. 82) says:

> The author believes that ultimately the great question of the permissible limit of stream pollution will be solved on this basis.

In view of all these facts it seemed highly desirable that the investigations of the pollution and self-purification of the Ohio River should include certain biological studies. The purpose of these studies may be said to have been twofold. There was first the general purpose of recording and classifying the available data as a contribution to the biology of streams in general. It was hoped that in addition an intensive study of the biology of the Ohio might furnish some information of immediate importance in the interpretation of the physical, chemical, and bacteriological data that it was proposed to assemble. This branch of the investigation was therefore organized with these two purposes in view.

METHODS EMPLOYED.

PLANKTON.

Purpose, scope, and plan of the biological work.—Recognition of the fact, often noted, that a sewage-polluted stream gradually becomes purified by natural means logically implies that the proper study of such a stream must include a careful survey of all known agents of nature which may be concerned in the purification process. With this end in view it was arranged to study the microscopic plants and animals and the related organisms predominating in the various portions of the river in order that additional data might be secured to consider in connection with the chemical and bacteriological data that were being secured meantime by a study of the same portions of the river.

Laboratories were established at six selected points along the river, as follows: (1) At Pittsburgh, where the Ohio River is formed by the confluence of the Allegheny and the Monongahela Rivers; (2) at Wheeling, 97 miles below Pittsburgh; (3) at Portsmouth, 355 miles below; (4) at Cincinnati, 480 miles; (5) at Louisville, 620 miles; and (6) at Paducah, 920 miles, respectively, down stream from Pittsburgh. The Paducah laboratory was within 47 miles of the Mississippi River, into which the Ohio River flows.

At each of these six cities several sampling stations were established in order to obtain representative samples of the water: (1) Above the city and untouched by local pollution; (2) below the city, and presumably showing the effects of any sewage, industrial waste, etc., introduced locally. Thus, at Pittsburgh, the several biological sampling points were located: (1) 12 miles up the Monongahela from the confluence at Pittsburgh, (2) 7 miles up the Allegheny, (3) 3 miles below the confluence at Pittsburgh, (4) 23 miles below the confluence. This last point also had reference to the condition of the Ohio water before the advent of the Beaver River, which entered at about 25 miles below Pittsburgh. Samples of this tributary were taken well up above the mouth to determine the biological status of this stream. Various other Ohio tributaries, regarded as important on account of their probable sanitary status or their effect as a dilution factor, were sampled in like manner.

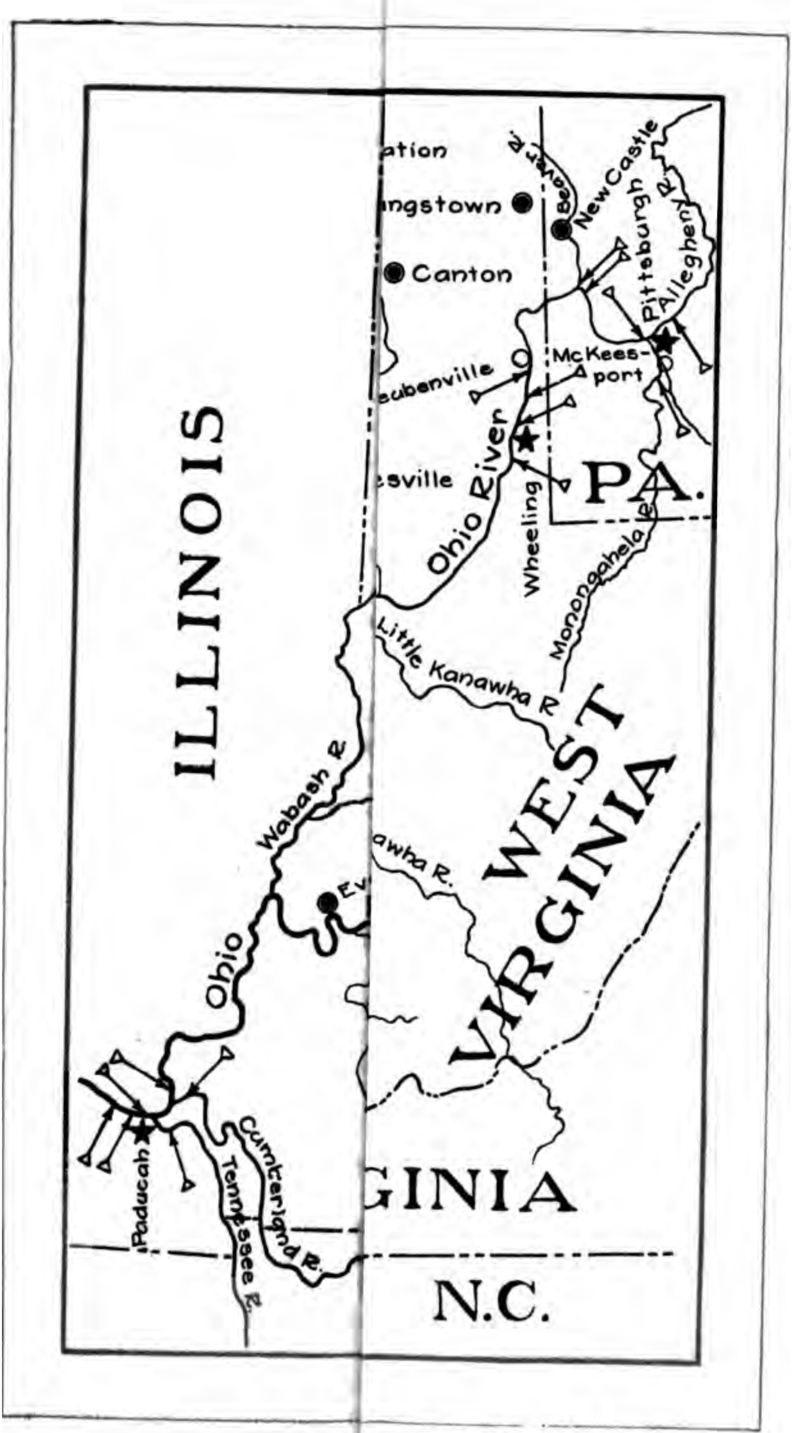
Plankton samples were taken weekly as a rule. Bottom sediments were sampled less often—twice a month, or in some cases once a month. The time period covered was August 1 to October 15, 1914, in all stations except those near Cincinnati, where some intensive work was continued until August, 1915.

Table No. 1, given herewith, lists the 6 successive laboratories, 26 collecting stations, time periods covered, frequency of collection, and kinds of samples secured in the effort to secure an adequate and impartial biological picture of the Ohio River. These sampling points are designated on the map of the Ohio River District also.

TABLE NO. 1—*Record of biological samples.*

Station.	Sampling point (miles from Pittsburgh).	Time included by samples collected.	Number of samples and frequency of collection.			
			Plankton (weekly).	Mud (semi-monthly).	Miscellaneous (occasional).	Total.
Pittsburgh	M-12	Aug. 12 to Oct. 15, 1914.	10	5	1	16
	A-7	do	10	7	1	18
	O-3	do	10	7	1	18
	O-23	do	10			10
	Beaver River	do	10	5	1	16
Total			50	24	4	78
Wheeling	65	Aug. 14 to Oct. 15, 1914.	9			9
	77	do	8			8
	88	do	[1] 4			4
	97 or dam No. 13	do	10			10
Total			31			31
Portsmouth	349	Aug. 18 to Oct. 15, 1914.	7	4	1	12
	Scioto River	do	7	3		10
	358	do	7	4		11
Total			21	11	1	33
Cincinnati	461	July 22, 1914, to Aug. 1, 1915.	46	10		56
	475	do	50	[2] 84		134
	492	Sept. 10, 1914, to Aug. 1, 1915.	49	[3] 49		98
	Little Miami River	Sept. 10, 1914, to May 20, 1915.	33	1		34
	Licking River	July 22, 1914, to June 1, 1915.	36	9	1	46
	Great Miami River	Sept. 10, 1914, to Aug. 1, 1915.	39	2	1	42
Total			253	155	2	410
Louisville	598	Aug. 31, 1914, to Aug. 1, 1915.	49	[3] 87	10	146
	619, N and C	Aug. 31, 1914, to May 1, 1915.	35	34		69
	619-S	do	36	1		37
Total			120	122	10	252
Paducah	904	Sept. 2 to Oct. 12, 1914.	5	3		8
	Cumberland River	do	4	4		8
	920, N and C	do	5	3		8
	920-S	do	4			4
	Tennessee River	do	6	5		11
	926-S	do	4	6		10
	933, N and C	do	5			5
	933-S	do	5			5
Total			38	21		59
Grand total			513	333	17	863

[1] Biweekly.
[2] To November, 1915.
[3] To December, 1915.



15077—28. (Face p. 14.)

ence of *Brachionus* in 5 of the 10 samples would indicate sufficient organic matter to furnish food to this rotifer, which is classed by some writers as a contaminate organism. (Eyferth, 1909, p. 534.) On the other hand, the better condition of the water is attested by the fact that the pollutional rotifers *R. actinurus* and *R. vulgaris*, which were fairly abundant at O–3, are entirely absent here; the pollutional protozoa *Anthophysa* and *Epistylis* are likewise absent. Moreover, a rotifer of recognized cleaner water environment, *Anuræa* (Kofoid, 1904, p. 151), is here found in four samples, while it was entirely absent at O–3. The minute algæ which constitute much of the food of this rotifer is present at both O–3 and O–23.

Perhaps the most notable feature of plankton at this station lies in the fact that, while rotifers hold first place quantitatively in August and September, the crustacea (*Cyclops*) assume this rôle in October and maintain it, as far as rotifers are concerned, in plankton collections farther down the river at Wheeling. In food habits *Cyclops* is a scavenger (Herrick, 1884), and its presence means the destruction of much of the organic matter that has thus far escaped or survived the attacks of bacteria, ciliates, and certain rotifers.

This station is in the lower part of pool formed by Dam No. 5, hence, between the last station considered, O–3, and this point intervenes a stretch of 20 miles of water, all of which is impounded by Dams Nos. 1 to 5, inclusive. According to data given in the hydrometric section of the full report,[1] the time of flow between these two stations was 5.59 days in August, 6.20 in September, and 12.49 days in October 1–15. It will thus be seen that the time interval concerned is out of all proportion to the distance traversed. That this very slow movement of water provides sufficient time interval for considerable biological activity would seem to be demonstrated by the fact that the plankton at O–23 is reduced in net amount and changed in regard to the predominating organisms.

Beaver River.—Samples from the Beaver River show a varying and rather abundant plankton made up of a well-balanced variety of forms and contributing from 4 to 13 per cent of the total catch.

Diatoms appear in every catch and are relatively abundant in eight catches, forming from 17 to 86 per cent of all organisms in the respective catches, the larger values being confined, with one exception, to the cooler temperatures of the last four weeks, September 15 to October 15. *Synedra delicatissima* was most abundant, appearing in every sample but one and forming the bulk of the entire catch in the last four samples, seemingly favored by the cooler weather. *S. biceps* and *S. ulna*, the latter classed by Senft (1905) as a pollutional organism, were present in moderate numbers in nearly all samples.

---

[1] Not yet published.

Minute green algæ, consisting of fragments of very small filamentous forms together with the unicellular *Pediastrum* and *Scenedesmus*, formed from 2 to 27 per cent of organisms in nearly all the catches. Small amounts of blue-greens were found in four samples. Chlorophyll-bearing flagellates of the Mastigophora, chiefly *Euglena viridis*, *Dinobryon*, and *Phacus*, were present in similar amounts. The diatoms, algæ, and green flagellates thus aggregate a volume of synthetic or plantlike organisms which is somewhat greater than the volume of plankton animals, as will be seen.

Of the plankton animals, *Difflugia*, a bottom rhizopod, was present in two samples, one of which was taken during rising levels and the other following the crest of a rise. Ciliates were represented by *Codonella* and *Tintinnus*, sparingly found in two samples. This scarcity of ciliates, which are usually abundant in contaminated water, is surprising, in consideration of the fact that the presence of pollution is indicated by *Euglena viridis* in a majority of the samples, and a similar organism, *Phacus*, is found in four samples.

Three samples contain the rotifer *Brachionus* in small to moderate numbers, and the contaminate rotifer *R. vulgaris* was found in two samples, but in small numbers. The rotifer *Anuræa cochlearis*, which is not characteristic of great pollution but abounds in water containing only moderate amounts of organic matter, was moderately abundant in 8 of the 10 samples. It is noticeable also that the minute chlorophyll-bearing organisms that form the greatest part of the food of this rotifer (Kofoid, 1904, p. 151) were found in all samples but one.

Crustacea appeared sparingly in two samples only. *Cyclops*, the leading form, thrives best in a stable environment as to water movement. (Kofoid, 1904, pp. 260, 267.) The mild but frequent fluctuations of the Beaver River during this period may explain, in part at least, the scarcity of crustacea. These disturbances of water levels will also explain the presence in four samples of a few nematode worms which normally live in bottom ooze or in decaying matter which would be disturbed by fluctuating movements of water.

The relatively heavy plankton of the Beaver River, averaging 4 to 13 per cent of the average total catch, indicates that conditions are, on the whole, favorable for plankton production. The one unfavorable condition thus far observed is found in the somewhat unstable hydrographic conditions. The fact that this does not seem to interfere with the presence of relatively abundant plankton would seem to indicate that other vital factors of plankton production are at their best, thus compensating in some degree for the unfavorable condition mentioned. It is therefore evident that food, in all probability sewage, is present in considerable amount, and in such stages

of decomposition as will best suit the requirements of such organisms as constitute the plankton. Toxic conditions, such as the acidity of water, which apparently limits to a few resistant organisms the plankton of the Monogahela River, are evidently absent from the Beaver River, for a large variety of organisms is included in the list of plankton.

Bottom deposits.—In addition to the samples of water taken for examination, a series of 20 samples of bottom mud was collected for the study of the life upon the bottom of the stream. The samples represented four of the five stations of this district, it having been impossible to obtain any mud at the bottom at Station O–23.

The tubificid worm, *Limnodrilus,* characteristic of sewage pollution, was found at each of the stations, but in increasing numbers with increasing pollution. It was comparatively rare in the Monongahela, and present in great abundance at Station O–3.

Some *Chironomus* larvæ and the associated form *Tanypus* were found occasionally.

In general, results are what might be expected from the known facts concerning the condition of pollution of the waters. The unfavorable effect of acidity is also observed, although here again it can not be stated whether this effect is primary or secondary.

SUMMARY OF BIOLOGICAL CONDITIONS IN THE PITTSBURGH DISTRICT.

The nearly equal urban and sewered populations of the two contributing watersheds tend to produce waters that, without consideration of other factors, upon their arrival at Pittsburgh are similarly contaminated. But the great variation of climatic, physical, and other factors make of the two streams distinctly different biological habitats. Prominent among these differences are geographical position, size of catchment area, slope of valley, detention of water by pools and dams, amount and kind of industrial wastes and mine drainage, and, finally, the distribution of population with reference to the time of flow from the points of pollution to the confluence at Pittsburgh.

The average yield of plankton in the lower Monongahela is considerably greater than that of the lower Allegheny. This condition is ascribed to the long storage period to which the Monongahela water is subjected, and the resulting age of the water, permitting extensive development of plankton life in the nearly motionless waters rich in the accumulated products of decay of organic matter.

But this heavy plankton is limited to a small assortment of organisms, presumably because the acid condition of the water kills off the smaller ones and the less resistant of the larger forms, both plant and animal, leaving to few surviving varieties the very large

supply of rich food that must be present in this old and heavily polluted water. The possibility of an acquired immunity having resulted from continuous exposure of successive generations to the acidity of the water is an interesting biological contingency.

The smaller plankton yield of the Allegheny seems to be due chiefly to water movement and consequent frequent replacement of water by that of more recent origin, thus cutting short the time period required for plankton production and for the requisite degree of decomposition of organic matter which results in suitable food for plankton organisms.

The waters, on combining, are subjected to a further time period of two to four days in reaching Station O–3, receiving in the meantime a large amount of sewage and of various industrial wastes along the Pittsburgh water front. The plankton at this station is not as large as conditions of food supply and time-factor seem to warrant, the discrepancy being due, in all probability, to the presence of harmful substances among the numerous industrial wastes discharged into the river. Before O–23 is reached Dams Nos. 1 to 5 have impounded the water for an additional period of 5½ to 12 days. The resulting plankton at O–23 is reduced in net amount and changed in character.

Organisms at M–12 can hardly be regarded as characteristic of pollution, except one rotifer (*R. vulgaris*), which is so classed by Eyferth (1909) and was found in 7 of the 10 samples.

The small amount of plankton at A–7 exhibits a varied assortment of organisms which do not, as a whole, indicate pollution. One distinctly pollutional organism is relatively abundant in one sample and is present in a second.

In plankton from O–3 distinctly pollutional and contaminate organisms are present in every sample but one.

Plankton from O–23 shows known pollutional organisms in two samples. The presence of the cleaner water rotifer *Anuræa* in four samples, together with the decline of rotifers as a class and the corresponding increase of crustacea, are significant of some improvement in the water since leaving Station O–3.

The Beaver River yields an abundant and well-assorted plankton, in which diatoms predominate. The rotifer *Anuræa* is found in most samples. Pollutional organisms are present in moderate and small numbers in 8 of the 10 samples.

Mud samples give throughout evidence of pollution.

It seems probable that these rotifers would find their chief food supply in the abundant organic matter in suspension in the water incident to heavy sewage pollution and incident, further, to the absence of sufficient bacterial life to dispose of this material.

We thus see at M–12 the unusual spectacle of a plankton which has responded to the very favorable conditions of environment, abundant food, and very long time-factor, but which has meantime been subject to some biological catastrophe which has nearly or quite eliminated the first few links in the chain of organisms whose interdependence arises from their food relations. The resulting plankton is large, but consists of a very small variety of the larger organisms—the biological end-product of the complicated reactions due to the dominant factors of abundant food, long storage, and, probably, acidity of water at this station.

Station A–7.—In the Allegheny at Station A–7 during the same period the temperature ranged from 24° C. to 16° C., turbidity from practically zero to 60, and river levels recorded by the gauge at Freeport, Pa., fluctuated from 0.7 to 2.2. The monthly average plankton content varied from 0.2 to 1 per cent of total catch.

Rhizopods held leading place in September and diatoms in October Noticeable features of plankton were variety of organisms present, unusual scarcity of organisms in August samples, and relatively small plankton yield at all times.

The water is of comparatively recent origin owing to the gradual and considerable slope of 2 feet per mile in the lower 85 miles of this river and owing, further, to the absence of any slack-water basin that is sufficient in size to impound the large discharge of this stream for more than a short period. The river is thus very sensitive to flood conditions, and consequently the short slack-water stretch just above Pittsburgh is subject to quite frequent renewals of the water. This condition is disastrous to plankton life generally (Kofoid, 1903, p. 458) by preventing that adequate decay of sewage which would furnish plankton life with abundant food and, further, by providing a time-factor which is far too short for the breeding of plankton in quantity. The partially decayed organic material, together with such plankton as may be present, are swept on into the Ohio by the frequent floods.

Conditions similar to the foregoing were found in the study of the Illinois River by Kofoid (1903, pp. 349, 458). The plankton production of a certain tributary (Spoon River) averaged only one-fiftieth that of the main stream, and the only available explanation was found in the fact that the water of the tributary was of recent origin and the relatively rapid current caused such frequent renewal of the water that there was insufficient time for the breeding of plankton in this tributary stream. Kofoid concluded: " *The age of* *the water* is, other things being equal, one of the most vital of all the hydrographic factors environing the plankton."

The organisms found in samples at Station A-7 apparently reflect the varied and somewhat unstable conditions of environment.

For some reason not apparent, August samples yielded very few organisms. Turbidity had reached a maximum of 90 the day preceding our first collection, although the gauge at Freeport showed a rise in levels of only 2 feet. It is possible that this influx of turbid water, probably from some tributary, reacted unfavorably on August plankton.

September samples reflected the moderate disturbance of river levels by showing predominance of the rhizopods *Difflugia* and *Arcella*, both of these organisms belonging normally to bottom sediments or to the surface of decaying plants or other organic matter. Their prominence in plankton samples is usually a function of disturbed conditions of stream flow. Holophytic (plantlike) organisms are moderately abundant as a result of comparatively low turbidity, premitting access of sunlight. In turn, the rotifer *Anuræa*, which feeds principally on minute plant life, is present in small numbers. *Anthophysa*, a colorless flagellate, usually abundant in contaminated water, is present also.

Cooler temperatures in October favor the growth of diatoms, which are found moderately abundant. A rise in water levels brought the bottom-loving organisms *Difflugia* and *Arcella* again into the plankton in the last sample, together with a large amount of suspended matter.

Station O-3.—Ten weekly samples taken at O-3 during this period of very moderate fluctuation as to temperature and turbidity show a monthly average plankton content of 7.6 to 8 per cent of the total catch.

Organisms present show moderate variety, rotifers predominating, comprising 91, 66, and 61 per cent of all the plankton forms in the three months, taken in order. Ciliates appear in moderate numbers. Crustacea and diatoms are present in small numbers. Neither diatoms nor algæ appear in August, both are found in September, and algæ again in October.

Hydrographic conditions were so nearly uniform and stable that the plankton catches may be regarded as truly representative of prevailing low-water conditions at this station—the first in the Ohio River proper.

Abundance of plankton in all catches means that suitable food for these organisms is plentiful. This necessity is evidently supplied partly from the two tributary streams that unite to form the Ohio River and partly from the great volume of sewage and industrial

waste contributed along the Pittsburgh water front. It is evident that this organic matter thus supplied from these sources will vary greatly in age and in stage of decomposition; that from the Monongahela having been subject to a very long time period, but in water of acid reaction; that from the Allegheny River representing a variety of ages on account of the widely scattered locations of the towns on its watershed; and, finally, the sewage and waste from Pittsburgh representing a comparatively fresh condition.

It would seem that this organic material of different kinds, of different ages, and hence in various degrees of decomposition, would supply all necessary food requirements for a large and varied assortment of plankton organisms.

The slack-water basin formed by the dam a short distance below this sampling point provides comparatively still water along the entire Pittsburgh water front, thus imposing on the mingled waters forming the Ohio River a moderately long time-factor which would tend to encourage biological activity. This, with the presence of abundant food, should produce a heavier growth of plankton than we find at O–3.

Reference to the chemical data reported in another section will show that during August, September, and October, when our samples were taken, the acidity of the Monongahela had been neutralized by the alkaline water of the Allegheny and the acid salts of the Monongahela had been largely eliminated. There are probably many reactions and adjustments taking place of which we have no direct knowledge. We know only these end reactions or the final outcome.

This beginning of the Ohio River at Pittsburgh is evidently the arena in which the dissimilar waters of the two tributaries settle their differences of chemical reaction and physical condition and acquire the final adjustments which appear in samples taken at O–11, this final outcome being hastened, or variously modified, presumably, by the large amount of industrial wastes and sewage introduced at Pittsburgh.

It seems highly probable that the acidity of the Monongahela might at times be a factor at O–3, for occasional acidity was noted in daily samples at O–11, where chemical samples were taken. This probability is strengthened, moreover, by the fact that during one month of this period (August) the discharge of the Monongahela was 2,070 second-feet and that of the Allegheny was 1,660 second-feet, a reversal of the usual order of relative discharge of these streams.

Any such occasional acidity at O–3 would be likely to exert unfavorable influence on the development of plankton life, as is the case at M–12. Moreover, the various changes in the concentration of dissolved materials (including acid salts) that must be a part of the process of readjustment in this physiochemical arena would un-

doubtedly show a biological reflection in a decreased plankton production.

The plankton-poor water of the Allegheny will function as a diluent of the more abundant plankton contributed by the Monongahela. Inasmuch as the usual discharge of the Allegheny is considerably in excess of that from the other tributary, it is no surprise that the plankton at O–3 reflects this diminished relative value and, to some extent, shows something of the variety of organisms which characterizes the scanty plankton contributed by the larger stream.

Abundance of organic matter is indicated at O–3 by the prevalence of the same rotifers, *Brachionus* and *Rotifer vulgarus*, which we find predominant at M–12. Distinctly pollutional organisms, *Anthophysa* of the Mastigophora and *Vorticella* and *Epistylis* of the Ciliata, appeared in five samples. *Vorticella* formed 29 per cent of the entire catch in one of these samples and from 1 to 9 per cent in three other samples. *Rotifer actinurus*, a pollutional organism (Forbes and Richardson, 1913, pp. 502, 513), appeared in moderate abundance in 1 sample, while in 7 of 10 samples the contaminate *Rotifer vulgaris* was abundant.

Station O–23.—At Station O–23, 10 weekly samples taken during a period of relative quiet as to water conditions show a moderate assortment of organisms. Rotifers predominate in two months and crustacea in one. Diatoms are abundant in one August sample Green algæ, Mastigophora, and ciliates are present in rather small numbers. A noticeable feature of collections here is the decline of rotifers as the leading plankton and the gradual advent of crustacea.

Diatoms (*Synedra delicatissima*) are abundant in one sample only, that of August 25. Temperature was 24° C. The sudden appearance of this organism, which is usually more abundant in cool weather than in warm, seems to be without explanation except for the fact that the "bear traps" had been lowered a few days before and the pools were drained of some of their surface water. This disturbance and readjustment of levels might be responsible for the appearance at this station of the relatively large number of diatoms whose growth and multiplication had probably taken place in some sheltered bit of water in one of the upstream dams. It is worth noting, also, that an unusual number of *Brachionus* (the same rotifer that is so abundant at O–3 and at M–12) appeared in this same August sample at O–23. The lowering of the "bear traps" was reported August 18, one week before this sample was taken.

The list of organisms, together with relative abundance of certain kinds, indicates some improvement in the water. Two organisms of recognized pollutional affinities, *Euglena viridis* and one of the *Vorticellidæ*, were present in moderate amount in one sample, and a very few of the former organism in a second sample. However, the presence of *Brachionus* in 5 of the 10 samples would indicate sufficient organic matter to furnish food to this rotifer, which is classed by some writers as a contaminate organism. (Eyferth, 1909, p. 534.) On the other hand, the better condition of the water is attested by the fact that the pollutional rotifers *R. actinurus* and *R. vulgaris*, which were fairly abundant at O–3, are entirely absent here; the pollutional protozoa *Anthophysa* and *Epistylis* are likewise absent. Moreover, a rotifer of recognized cleaner water environment, *Anuræa* (Kofoid, 1904, p. 151), is here found in four samples, while it was entirely absent at O–3. The minute algæ which constitute much of the food of this rotifer is present at both O–3 and O–23.

Perhaps the most notable feature of plankton at this station lies in the fact that, while rotifers hold first place quantitatively in August and September, the crustacea (*Cyclops*) assume this rôle in October and maintain it, as far as rotifers are concerned, in plankton collections farther down the river at Wheeling. In food habits *Cyclops* is a scavenger (Herrick, 1884), and its presence means the destruction of much of the organic matter that has thus far escaped or survived the attacks of bacteria, ciliates, and certain rotifers.

This station is in the lower part of pool formed by Dam No. 5, hence, between the last station considered, O–3, and this point intervenes a stretch of 20 miles of water, all of which is impounded by Dams Nos. 1 to 5, inclusive. According to data given in the hydrometric section of the full report,[1] the time of flow between these two stations was 5.59 days in August, 6.20 in September, and 12.49 days in October 1–15. It will thus be seen that the time interval concerned is out of all proportion to the distance traversed. That this very slow movement of water provides sufficient time interval for considerable biological activity would seem to be demonstrated by the fact that the plankton at O–23 is reduced in net amount and changed in regard to the predominating organisms.

Beaver River.—Samples from the Beaver River show a varying and rather abundant plankton made up of a well-balanced variety of forms and contributing from 4 to 13 per cent of the total catch.

Diatoms appear in every catch and are relatively abundant in eight catches, forming from 17 to 86 per cent of all organisms in the respective catches, the larger values being confined, with one exception, to the cooler temperatures of the last four weeks, September 15 to October 15. *Synedra delicatissima* was most abundant, appearing in every sample but one and forming the bulk of the entire catch in the last four samples, seemingly favored by the cooler weather. *S. biceps* and *S. ulna*, the latter classed by Senft (1905) as a pollutional organism, were present in moderate numbers in nearly all samples.

---

[1] Not yet published.

Minute green algæ, consisting of fragments of very small filamentous forms together with the unicellular *Pediastrum* and *Scenedesmus*, formed from 2 to 27 per cent of organisms in nearly all the catches. Small amounts of blue-greens were found in four samples. Chlorophyll-bearing flagellates of the Mastigophora, chiefly *Euglena viridis*, *Dinobryon*, and *Phacus*, were present in similar amounts. The diatoms, algæ, and green flagellates thus aggregate a volume of synthetic or plantlike organisms which is somewhat greater than the volume of plankton animals, as will be seen.

Of the plankton animals, *Difflugia*, a bottom rhizopod, was present in two samples, one of which was taken during rising levels and the other following the crest of a rise. Ciliates were represented by *Codonella* and *Tintinnus*, sparingly found in two samples. This scarcity of ciliates, which are usually abundant in contaminated water, is surprising, in consideration of the fact that the presence of pollution is indicated by *Euglena viridis* in a majority of the samples, and a similar organism, *Phacus*, is found in four samples.

Three samples contain the rotifer *Brachionus* in small to moderate numbers, and the contaminate rotifer *B. vulgaris* was found in two samples, but in small numbers. The rotifer *Anuræa cochlearis*, which is not characteristic of great pollution but abounds in water containing only moderate amounts of organic matter, was moderately abundant in 8 of the 10 samples. It is noticeable also that the minute chlorophyll-bearing organisms that form the greatest part of the food of this rotifer (Kofoid, 1904, p. 151) were found in all samples but one.

Crustacea appeared sparingly in two samples only. *Cyclops*, the leading form, thrives best in a stable environment as to water movement. (Kofoid, 1904, pp. 260, 267.) The mild but frequent fluctuations of the Beaver River during this period may explain, in part at least, the scarcity of crustacea. These disturbances of water levels will also explain the presence in four samples of a few nematode worms which normally live in bottom ooze or in decaying matter which would be disturbed by fluctuating movements of water.

The relatively heavy plankton of the Beaver River, averaging 4 to 13 per cent of the average total catch, indicates that conditions are, on the whole, favorable for plankton production. The one unfavorable condition thus far observed is found in the somewhat unstable hydrographic conditions. The fact that this does not seem to interfere with the presence of relatively abundant plankton would seem to indicate that other vital factors of plankton production are at their best, thus compensating in some degree for the unfavorable condition mentioned. It is therefore evident that food, in all probability sewage, is present in considerable amount, and in such stages

of decomposition as will best suit the requirements of such organisms as constitute the plankton. Toxic conditions, such as the acidity of water, which apparently limits to a few resistant organisms the plankton of the Monogahela River, are evidently absent from the Beaver River, for a large variety of organisms is included in the list of plankton.

Bottom deposits.—In addition to the samples of water taken for examination, a series of 20 samples of bottom mud was collected for the study of the life upon the bottom of the stream. The samples represented four of the five stations of this district, it having been impossible to obtain any mud at the bottom at Station O–23.

The tubificid worm, *Limnodrilus,* characteristic of sewage pollution, was found at each of the stations, but in increasing numbers with increasing pollution. It was comparatively rare in the Monongahela, and present in great abundance at Station O–3.

Some *Chironomus* larvæ and the associated form *Tanypus* were found occasionally.

In general, results are what might be expected from the known facts concerning the condition of pollution of the waters. The unfavorable effect of acidity is also observed, although here again it can not be stated whether this effect is primary or secondary.

SUMMARY OF BIOLOGICAL CONDITIONS IN THE PITTSBURGH DISTRICT.

The nearly equal urban and sewered populations of the two contributing watersheds tend to produce waters that, without consideration of other factors, upon their arrival at Pittsburgh are similarly contaminated. But the great variation of climatic, physical, and other factors make of the two streams distinctly different biological habitats. Prominent among these differences are geographical position, size of catchment area, slope of valley, detention of water by pools and dams, amount and kind of industrial wastes and mine drainage, and, finally, the distribution of population with reference to the time of flow from the points of pollution to the confluence at Pittsburgh.

The average yield of plankton in the lower Monongahela is considerably greater than that of the lower Allegheny. This condition is ascribed to the long storage period to which the Monongahela water is subjected, and the resulting age of the water, permitting extensive development of plankton life in the nearly motionless waters rich in the accumulated products of decay of organic matter.

But this heavy plankton is limited to a small assortment of organisms, presumably because the acid condition of the water kills off the smaller ones and the less resistant of the larger forms, both plant and animal, leaving to few surviving varieties the very large

supply of rich food that must be present in this old and heavily polluted water. The possibility of an acquired immunity having resulted from continuous exposure of successive generations to the acidity of the water is an interesting biological contingency.

The smaller plankton yield of the Allegheny seems to be due chiefly to water movement and consequent frequent replacement of water by that of more recent origin, thus cutting short the time period required for plankton production and for the requisite degree of decomposition of organic matter which results in suitable food for plankton organisms.

The waters, on combining, are subjected to a further time period of two to four days in reaching Station O–3, receiving in the meantime a large amount of sewage and of various industrial wastes along the Pittsburgh water front. The plankton at this station is not as large as conditions of food supply and time-factor seem to warrant, the discrepancy being due, in all probability, to the presence of harmful substances among the numerous industrial wastes discharged into the river. Before O–23 is reached Dams Nos. 1 to 5 have impounded the water for an additional period of 5½ to 12 days. The resulting plankton at O–23 is reduced in net amount and changed in character.

Organisms at M–12 can hardly be regarded as characteristic of pollution, except one rotifer (*R. vulgaris*), which is so classed by Eyferth (1909) and was found in 7 of the 10 samples.

The small amount of plankton at A–7 exhibits a varied assortment of organisms which do not, as a whole, indicate pollution. One distinctly pollutional organism is relatively abundant in one sample and is present in a second.

In plankton from O–3 distinctly pollutional and contaminate organisms are present in every sample but one.

Plankton from O–23 shows known pollutional organisms in two samples. The presence of the cleaner water rotifer *Anuræa* in four samples, together with the decline of rotifers as a class and the corresponding increase of crustacea, are significant of some improvement in the water since leaving Station O–3.

The Beaver River yields an abundant and well-assorted plankton, in which diatoms predominate. The rotifer *Anuræa* is found in most samples. Pollutional organisms are present in moderate and small numbers in 8 of the 10 samples.

Mud samples give throughout evidence of pollution.

ination of sediments are correlated with the results of plankton examination, and the careful inspection of such deposits is accordingly of importance in the biological survey of a stream.

Biological balance as seen in the Ohio River means the presence of organisms in such number and in such assorted varieties as will successfully cooperate with existing chemical and physical conditions in the effective reduction of the organic matter which may enter the water and in carrying on the continuous flux of this matter from the lowest forms of life to the highest. This includes the work of bacteria, of plankton, and of larger organisms. The presence of organic matter such as sewage results in abundance of animal forms rather than plants (aside from bacteria), while dissolved inorganic matter resulting from advanced decomposition favors the presence of plants as the dominating organisms. The middle ground between these two extremes is characterized by presence of a great variety of both animal and plant forms.

Information concerning the history, present condition, and rate and direction of change of a natural water may be obtained from the results of suitable chemical and bacteriological tests. This information is obtainable from such tests only because of extensive preceding studies, during the course of which correlations have been established and methods of procedure have been modified and adapted to secure reliable information with the minimum of possible error of interpretation. The great majority of these investigations have not, however, included an examination of the plankton and related organisms, nor have the tabulated results accredited anything to the activity of these biological workmen. Inasmuch as these organisms are present (and sometimes very numerous) in practically every natural water, it would seem that an adequate examination of this water must include a study of this ever-present biological factor, for otherwise certain phases of the final interpretation will be open to question. It seems reasonable that correlations should exist between this aquatic life and the degree of pollution and extent of self-purification of the water concerned, similar to the correlations which appear when the bacterial content and chemical condition of such waters are studied. To discover and record these correlations is the first task of the biologists who would continue the investigations begun by Forbes, Kofoid, Haeckel, Marsson, Kolkwitz, Eyferth, and others. To determine by long-continued observation and special laboratory tests to what extent and in what ways this biological factor may affect the bacteriological and chemical conditions, and be in turn affected by them, and the manner in which all these factors, together with the physical features, are mutually related in the process of self-purification of streams is the next group of problems awaiting solution.

backed-up water of Wheeling Creek, which is bubbling and offensive in consequence of the septic action resulting.

Three sampling stations were utilized in the study of the waters of this district. The upper station, O–65, is 40 miles below the mouth of the Beaver and 25 miles above Wheeling; the middle station, O–77, lies between Steubenville and Wheeling; and the lower station, O–97, is at the lower end of the basin formed by Dam No. 13 and about 6 miles below Wheeling, all in slack water at low river stages.

Samples were taken at weekly intervals from each of these stations during August, September, and October, 1914. The hydrographic conditions were unusually stable. The average results of these examinations are recorded in Table No. 1, page 14, and the principal features are shown graphically in planktograph No. 2.

Station O–65.—This station yielded a moderately light plankton containing few pollutional organisms, but with crustacean scavengers rather abundant.

The Beaver River and East Liverpool, 20 miles above this point, constitute the only recent pollution. The Beaver River increases the volume of the Ohio by about 10 per cent and contributes a heavy plankton made up of a varied assortment of organisms. After 40 miles of flow and with these influences at work the station under consideration yields a plankton which differs from that at Station O–23 in being less abundant and in showing better biological balance.

Three dams are located in the stretch between the mouth of Beaver River and Station O–65. The impounding action is accentuated by the low water levels prevailing in the Ohio River during this period.

The hydrometric studies show that the mean time interval between O–23 and O–65 during 1914 was 4.9 days in August, 6.14 days in September, and 11.35 days in the first half of October.

Station O–77.—The important features of the results at Station O–77 as contrasted with those at Station O–65 are the greater abundance of plankton, the increased proportion of crustacea, the higher numbers of diatoms and lower numbers of algæ, and the regular occurrence in small numbers of *Euglena viridis* of recognized pollutional habitat.

The two stations are essentially similar in regard to the organisms that predominate. In both, diatoms lead, except in August at Station O–77, and crustacea are abundant, exceeding the rotifers in total volume.

The relatively large amount of plankton is significant, considering the fact that thus far there has been a successive and consistent decrease as the Stations O–3, O–23, and O–65 are reached. It is indicated, therefore, that the steady decrease in plankton content noted in the upper stations was due to food exhaustion, and that

TABLE No. 6.—*Microscopical examination (average results)*—Continued.

Station.	Number of samples.	Temperature (C.).	Turbidity (p. p. m.).	Gage height (feet).	Organisms and other matter (standard units per c. c.).											Volumetric data (c. c. per cubic meter).	
					Holophytic.			Holozoic.						Total plankton.	Amorphous matter and silt.		
					Diatoms.	Algæ.	Mastigophora.	Fungi.	Rhizopoda.	Ciliata.	Rotifera.	Crustacea.	Vermes, etc.			Total catch.	Plankton.
CINCINNATI DISTRICT.																	
August–October, 1914.																	
461	8	20.7	115	....	149 ba	56 cae	3	....	8	10 b	11 c	....	1	239	17,108	135	1.8
Little Miami River	6	......	40	6.1	34 bf	66 abc	14 d	....	8	18 e	40 ba	....	13	194	20,909	95.7	.87
Licking River	6	52	140	1.7	3	24 g	32 ce	....	29 a	9 h	63 b	6	1	165	29,817	60	.33
475	10	20.5	227	6.2	51 ba	41 cb	21	+	3	45 bch	66 ac	8	26	265	20,635	65.2	.87
Miami River	8	18	67	2.2	41 ag	95 abc	15 cf	2	2	15 db	....	38 a	15 a	225	28,340	102	.66
492	6	19	77.5	6.1	34 b	35 ca	7	....	2	29 bc	18 ca	18 a	1	143	16,625	85.75	1.34
November, 1914–January, 1915.																	
461	12	5.4	44	17.6	396 bce	15 be	27 b	....	....	17 c	23 cf	....	....	478	80,129	172.6	2.4
Little Miami River	11	......	190	8	216 fcgh	17 ae	3	1	10 a	2	....	....	12 a	264	80,306	221.5	.71
Licking River	10	7	166	45	66 a	15 ae	14 e	+	4 a	1	8	....	29 ab	138	171,080	308	.27
475	14	4	190	17.3	470 bce	103 ce	20 e	1	8 b	8 ac	15 a	....	12 a	639	208,232	456.5	2.32
Miami River	6	1	27	3.7	79 a	10 e	5	....	1	7	25 c	....	3	130	57,762	177.5	.42
492	13	5	210	17.7	532 bfc	60 ec	31 e	+	....	16 b	29	....	83 a	753	114,587	439	10.65
February–March, 1915.																	
461	8	4	......	......	44 c	5	1	6	7 a	4	10	....	27 a	105	46,087	191	.39
Little Miami River	8	4	88	8.9	20 cj	10 e	2	....	14 a	8 ba	24 b	....	18 a	95	52,062	173.5	.47
Licking River	9	......	154	5.4	10 ac	5 h	1	1	4 a	2	3	....	32 a	58	58,859	172.5	.21
475	9	4	130	261	25 a	3	....	1	4	3 a	11 bd	9 a	36 a	94	81,622	175.8	.32
Miami River	9	5	31	5.3	43 a	6	1	2	8 a	19 hcj	1	....	28 ac	108	103,044	246	.48
492	9	3.5	103	27.9	31 aj	18 e	....	3	15 a	11	6	2	23 a	105	102,900	279.5	.28
April–May, 1915.																	
461	8	15.5	24	......	502 ef	8 c	26 be	....	6	11 ba	62 ca	....	1	617	35,593	102.6	1.64
Little Miami River	7	17	......	6.2	300 fbj	59 ced	76 fd	....	7 c	38 fg	86 ba	....	6	573	16,286	81.1	2.8
Licking River	7	......	164	3.1	79 fa	40 gc	80 f	....	6	14 b	145 afb	....	28 a	394	111,000	211	1.01
475	7	15	35	12	819 bce	14 ca	9 cf	3	4	17 ab	7 c	....	14	348	17,614	62.2	1.30
Miami River	8	16	29	......	1,143 fce	207 cbj	82 fc	4	8	15 a	118 baf	10 a	24 ac	1,501	42,802	118.2	4.72
492	8	15	119	12.6	469 cbe	46 ec	14	....	29 a	40 hb	35 ac	8	18	058	104,150	187	.18

June–July, 1915.																	
461	10	22	...	...	31 f	22 aecf	7 e	2	29 ae	33 bd	15 c	...	57 a	194	319,298	823	.46
475	9	23	401	16	22 k	29 eac	25 ec	2	35 ab	65 bda	11	5	21 a	213	222,022	685	.65
Miami River	5	...	...	...	5	19 b	3	...	52 a	41 b	18 c	1	20 a	159	250,200	767	.49
492	9	23	668	17.3	17 k	19 c	14 e	3	19 a	20 ab	34 c	...	18	144	323,511	888	.42
LOUISVILLE DISTRICT.																	
September–October, 1914.																	
598	9	21	71	5.4	21 b	68 a	1	...	+	24 b	109 ca	75 a	19	319	6,959	38.7	2.36
619	17	20	89	5.2	28 b	88 ac	49	2	3	29 b	44 c	3	7	252	9,052	894	1.48
November, 1914–January, 1915.																	
598	14	5	239	18.1	422 bcj	28 afc	32 e	4	29 a	161 b	35 bcd	2	21 a	734	171,402	546.5	3.76
619	24	19	23	16.5	464 bea	34 ea	46 de	+	44 a	10 b	23 ab	3	13 a	638	167,999	450	2.52
February–March, 1915.																	
598	9	4.3	148	26	21 a	3	13 e	...	47 a	1	1	...	36 a	124	146,511	336	.3
619	18	4	150	20.9	22 a	2	5	...	38 a	3	...	...	38 a	109	77,843	301.5	.42
April–May, 1915.																	
598	61	5	17	10	175 ae	25 b	13 f	1	2	8 b	17 c	...	1	243	9,258	44.9	1.21
619	8	14	22	10	248 bae	32 cad	13	...	8	12 b	16 a	...	9	339	11,825	52.5	1.44
June–July, 1915.																	
598	9	24.5	260	161	7	8	5	...	44 a	22 b	15 c	6	18 a	125	143,655	534	.48
PADUCAH DISTRICT.																	
September–October, 1914.																	
904	5	23	100	...	31 b	60 ac	...	...	...	10 b	90 ca	40 a	1	235	14,700	50.5	.87
Cumberland River	4	24	199	...	1	15 e	4	...	20 a	37 d	22 a	...	3	101	11,550	41.2	.3
920	9	23	109	...	47 ba	41 ab	+	...	30 a	37 d	94 a	38 ad	+	289	14,522	47.8	1.08
Tennessee River	6	25	82	...	10	6	2	...	8	37 bd	1	...	3	67	14,050	40.5	.19
926	4	24	132	...	32 ak	32 ab	1	...	12 a	21 b	37 a	...	...	134	12,300	37.4	.4
933	10	23	123	...	20 b	38 a	...	...	10	38 bd	42 a	20 c	4	173	13,820	42.7	.48

REFERENCES.

Calkins, G. L................1909. Protozoology.

Collins, F. S................1909. The Green Algæ of North America. Tufts College Studies, Vol. II, No. 3.

Conn, H. W..................1905. Protozoa of Fresh Waters of Connecticut.

Conn, H. W..................1908. Algæ of Fresh Waters of Connecticut.

Eyferth, B..................1909. Einfachste Lebensformen.

Field, G. W..................——. Report on Charles River Dam.

Forbes and Richardson......1913. Biology of the Upper Illinois.

Herrick, C. L................1884. Crustacea of Minnesota.

Hudson and Gosse...........1889. The Rotifera.

Kofoid, C. A................1903. Bulletin Illinois State Laboratory of Natural History, Vol. VI.

Kofoid, C. A................1904. Bulletin Illinois State Laboratory of Natural History, Vol. VIII.

Kolkwitz, R.................1911. Biologie des Trinkwassers, Abwassers und der Vorfluter.

Leidy, Joseph................1879. Fresh-Water Rhizopods of North America.

Marsson, Max................1911. Lecture translated in Engineering News of August 31, 1911.

Miall, L. C..................1912. Aquatic Insects.

Palmer, T. C................1897. Proceedings Philadelphia Academy of Natural Sciences.

Purdy, W. C................1916. Potomac Plankton. Hygienic Laboratory Bulletin No. 104.

Rafter and Baker............1900. Sewage Disposal in the United States.

Senft, E....................1902. Grundzüge für die biologische Beurteilung des Wassers nach seiner Flora und Fauna.

Senft, E....................1905. Untersuchung des Wassers.

Snow, Julia W...............1903. The Plankton Algæ of Lake Erie.

Tilden, Josephine...........1910. Minnesota Algæ.

Whipple, George W..........1913. Report Sewage Disposal System of Rochester, N. Y.

Whipple, George W..........1914. Microscopy of Drinking Water. Third ed.

Wolle, F....................1887. Fresh-Water Algæ of the United States.

Wolle, F....................1892. Desmids of the United States.

Wolle, F....................1894. Diatomaceæ of North America.

EXPLANATORY NOTE.

In the planktographs which follow all organisms are expressed in volumetric terms of cubic standard units instead of numbers.

Organisms whose life processes are essentially plantlike are classed as Plants, and are plotted in the upper half of the chart. Similarly, organisms whose life processes are essentially those of an animal are classed as Animals, and are plotted in the lower half of the chart.

Data of tributary streams are inserted in a narrow vertical space which extends across the chart from top to bottom near the point where this tributary enters the main stream. The various plankton forms are here represented by symbols, with the appropriate abbreviation placed near.

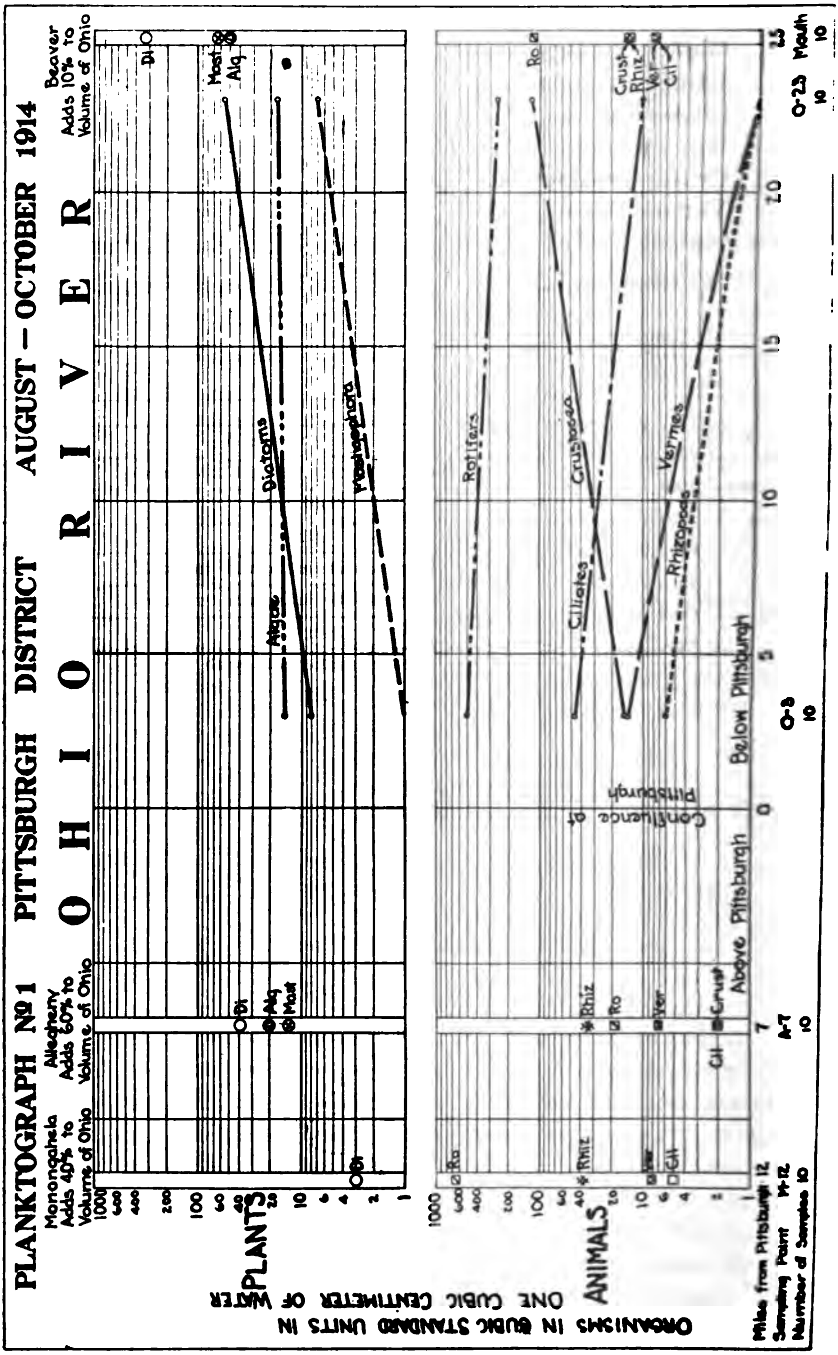
The following abbreviations are used:

Di.—diatoms.
Alg.—algæ.
Mast.—mastigophora.
Rhiz.—rhizopods.
Cil.—ciliates.
Ro.—rotifers.
Crus.—crustacea.
Ver.—vermes.

Data relating to the samples are placed below the diagram proper.

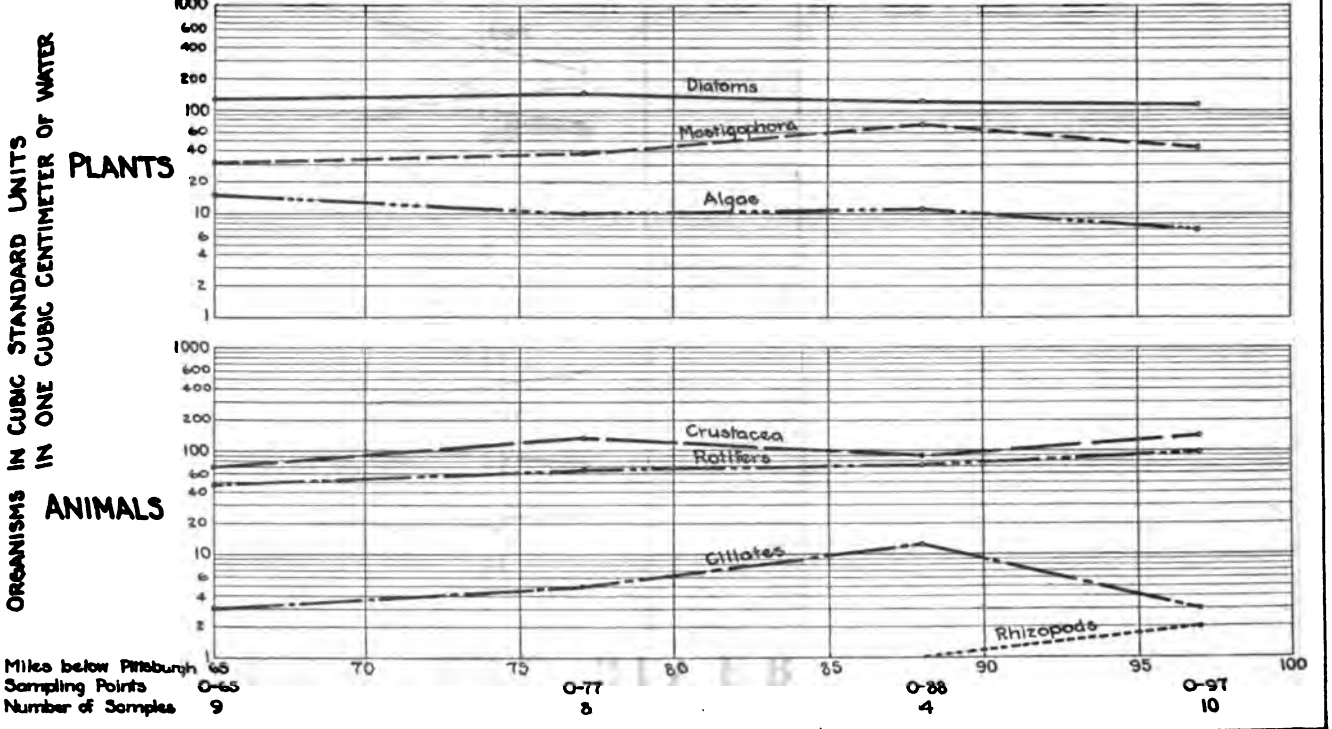
MANNER OF INDICATING ORGANISMS ON PLANKTOGRAPHS.

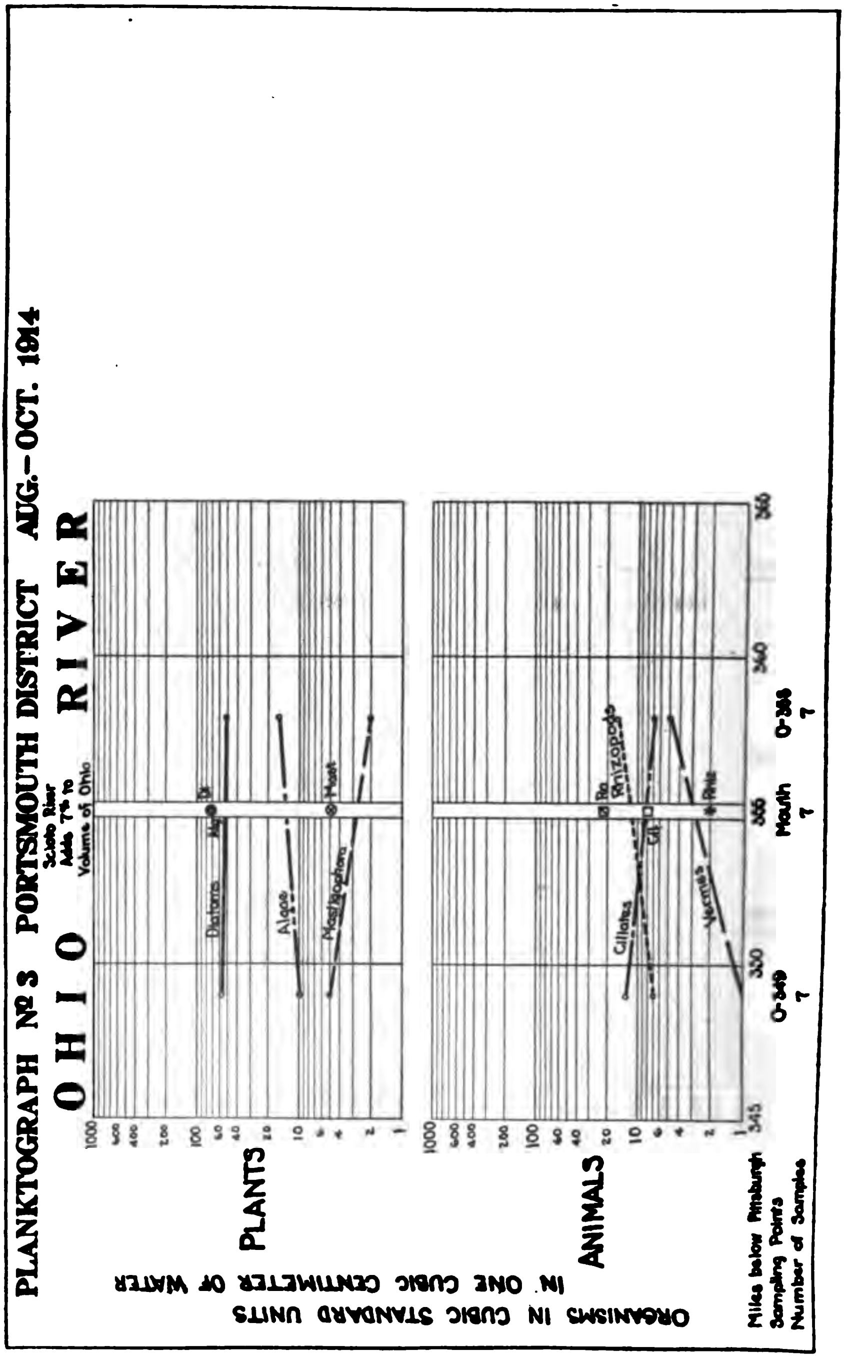
Organism.	Abbreviation used.	Designating mark for organisms.
Diatoms	**Di**	──────────────────── (Unbroken line.)
Algæ	**Alg**	—— . . . —— . . . —— . . . —— . . . —— . . . —— . . (Long dash alternating with three dots.)
Mastigophora	**Mast**	– (Short dashes.)
Rhizopoda	**Rhiz**	. . . . (Dots.)
Ciliata	**Cil**	—— . —— . —— . —— . —— . —— . —— . —— . —— . —— . —— (Long dash alternating with one dot.)
Rotifera	**Ro**	—— . . —— . . —— . . —— . . —— . . —— . . —— . . —— (Long dash alternating with two dots.)
Crustacea	**Crus**	—— —— —— —— —— —— —— —— —— —— —— —— —— —— (Long dashes.)
Vermes	**Ver**	—— x —— x —— x —— x —— x —— x —— x —— x —— x —— x —— (Long dash alternating with "x.")


PLANKTOGRAPH No 1 PITTSBURGH DISTRICT AUGUST – OCTOBER 1914
O H I O R I V E R
Monongahela Adds 40% to Volume of Ohio
Allegheny Adds 60% to Volume of Ohio
Beaver Adds 10% to Volume of Ohio
PLANTS
ANIMALS
ORGANISMS IN CUBIC STANDARD UNITS IN ONE CUBIC CENTIMETER OF WATER
1000
600
400
200
100
60
40
20
10
6
4
2
1
Di
Alg
Mast
Diatoms
Algae
Mastigophora
Ro
Rhiz
Ver
Cil
Crust
Rotifers
Crustacea
Ciliates
Vermes
Rhizopoda
Confluence at Pittsburgh
Above Pittsburgh
Below Pittsburgh
Miles from Pittsburgh 12
7
0
5
10
15
20
25
Sampling Point M-12
A-7
O-8
O-23
Mouth
Number of Samples 10
10
10
10
10

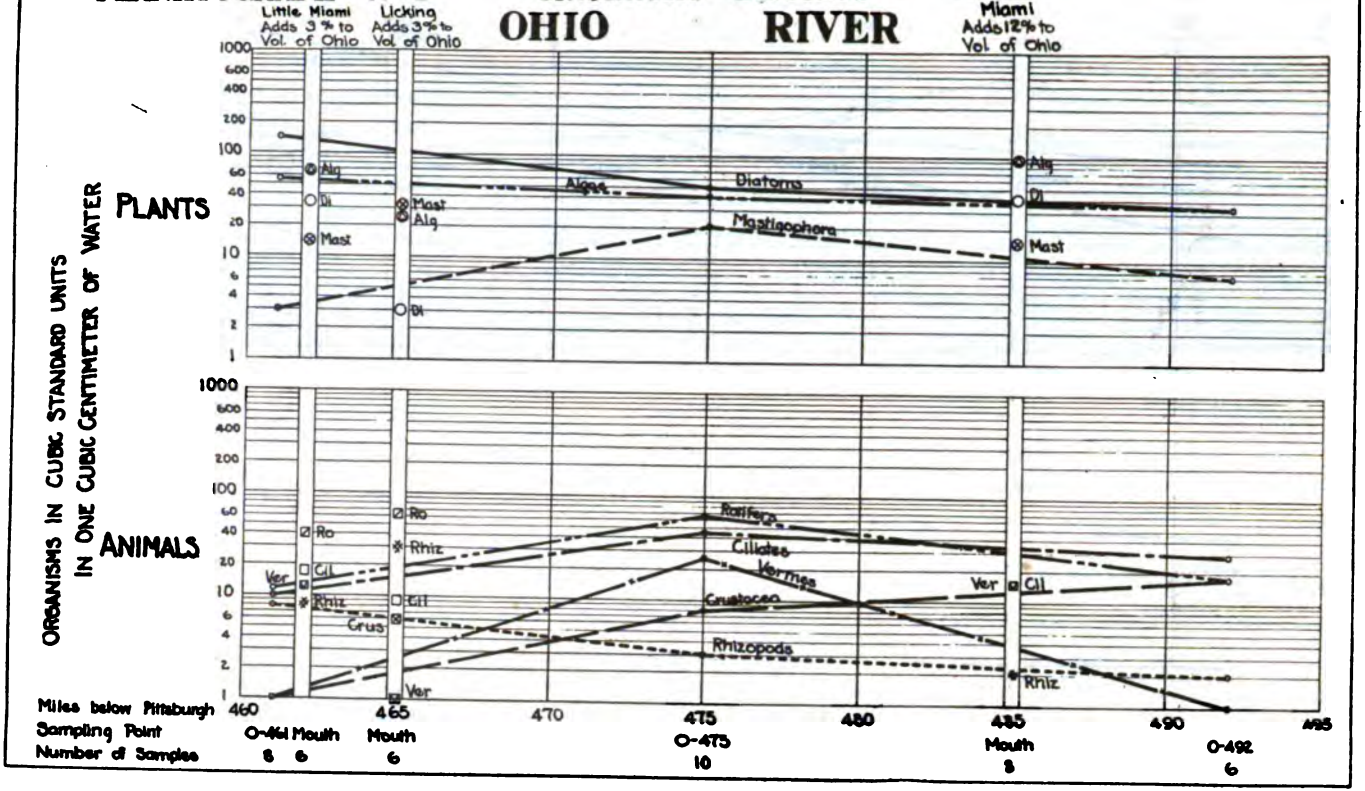
PLANKTOGRAPH Nº 2 WHEELING DISTRICT AUGUST – OCTOBER 1914

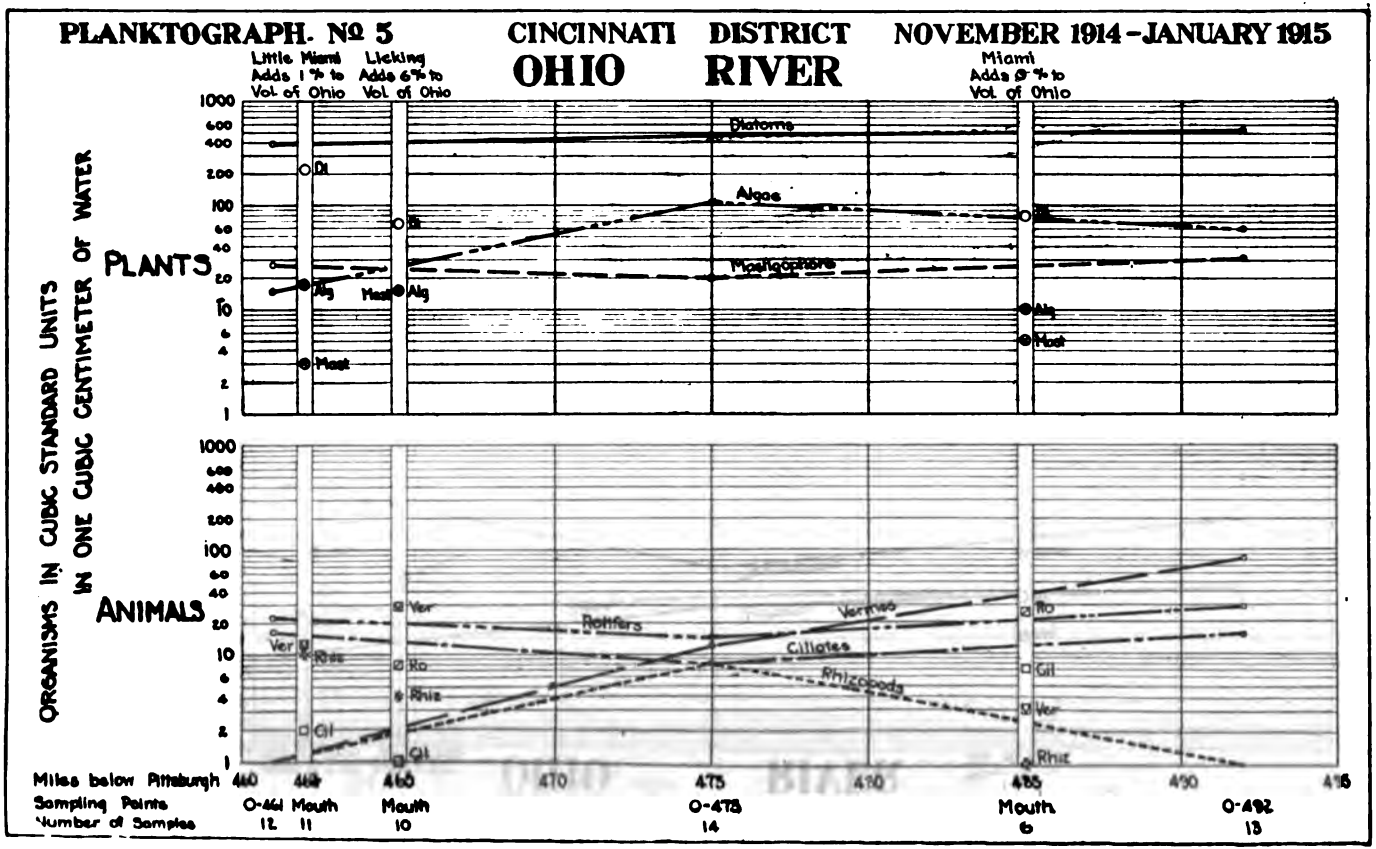
O H I O R I V E R




PLANKTOGRAPH No 3 PORTSMOUTH DISTRICT AUG.–OCT. 1914
OHIO RIVER
Scioto River
Adds 7% to
Volume of Ohio
PLANTS
ANIMALS
ORGANISMS IN CUBIC STANDARD UNITS
IN ONE CUBIC CENTIMETER OF WATER
1000
600
400
200
100
60
40
20
10
6
4
2
1
Diatoms
Algae
Mastigophora
Dt
Alg
Mast
Ciliates
Rhizopoda
Vermes
Rh
Cil
Rots
345
350
355
360
365
Miles below Pittsburgh
Sampling Points
Number of Samples
O-349
Mouth
O-358
7
7
7

PLANKTOGRAPH № 4 CINCINNATI DISTRICT AUGUST – OCTOBER 1914





PLANKTOGRAPH. NO 5 CINCINNATI DISTRICT NOVEMBER 1914 - JANUARY 1915

OHIO RIVER

PLANKTOGRAPH No 6 CINCINNATI DISTRICT FEBRUARY – MARCH 1915

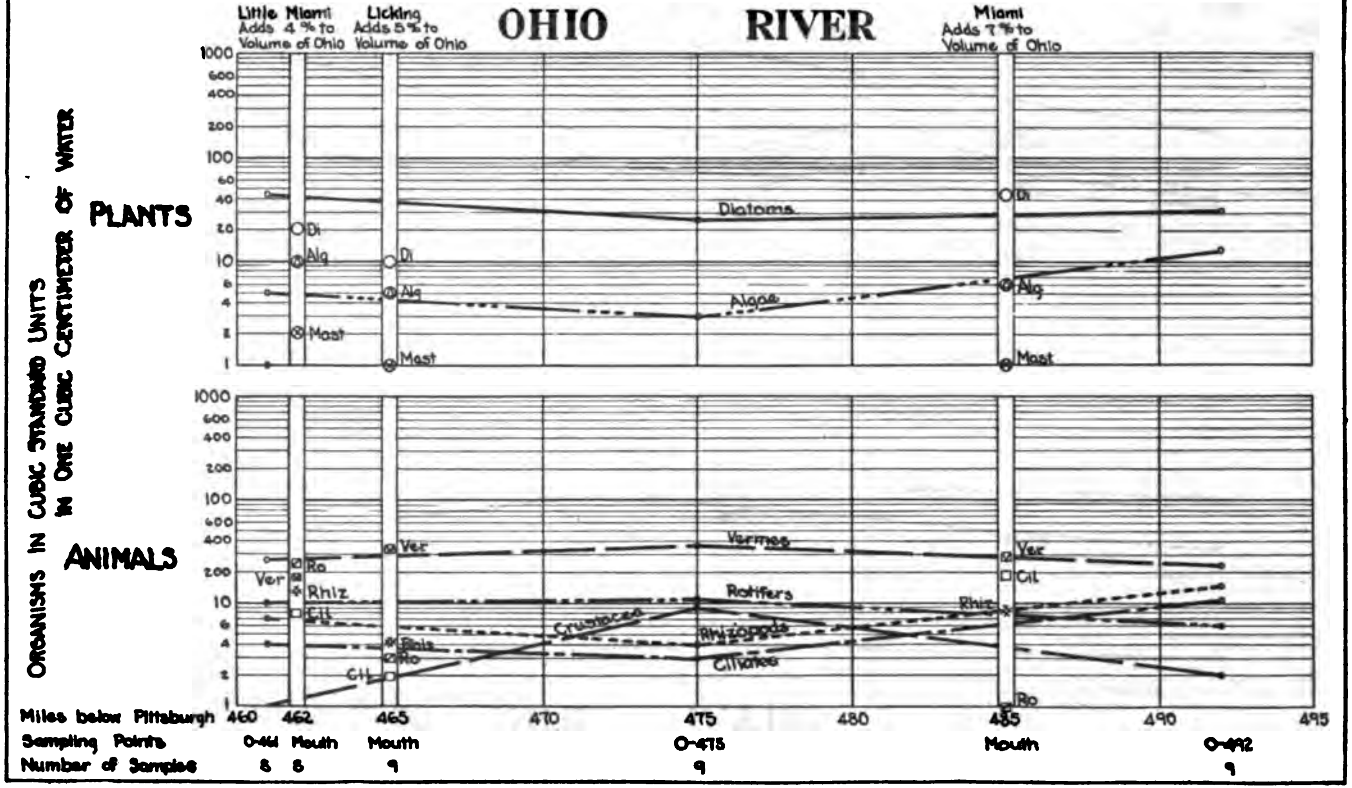


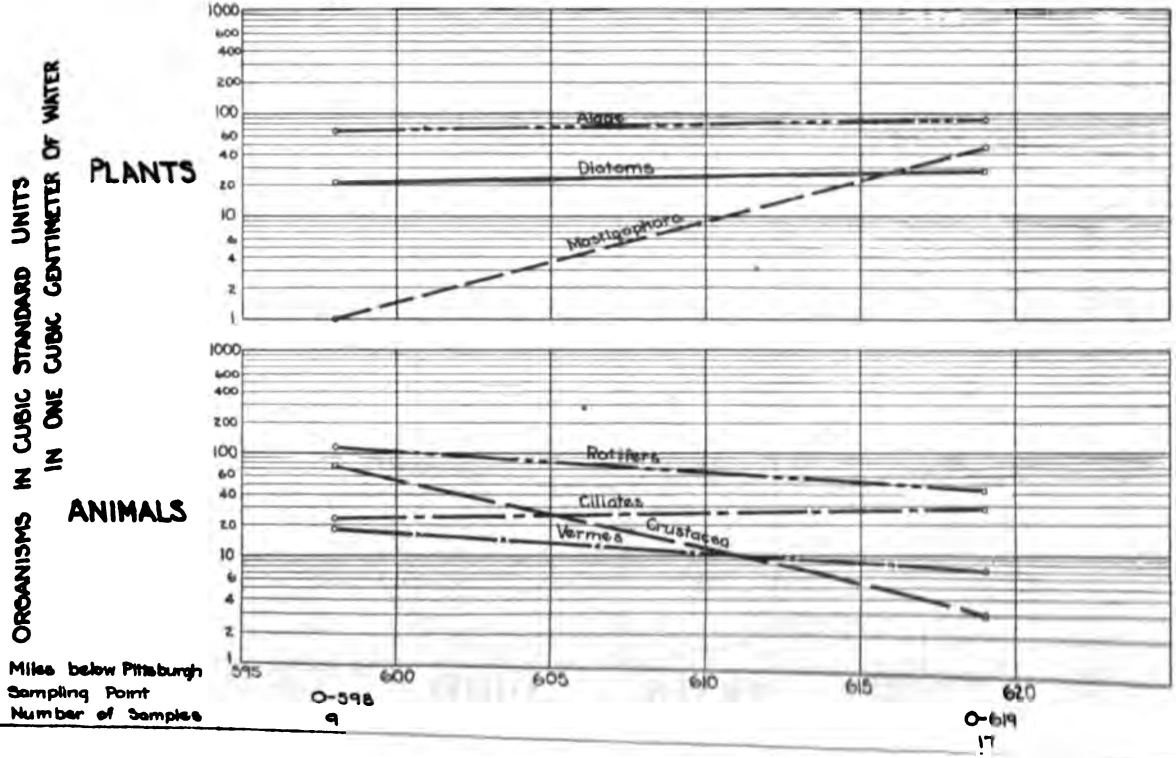
TABLE No. 6.—*Microscopical examination (average results)*—Continued.

Station.	Number of samples.	Temperature (C.).	Turbidity (p. p. m.).	Gage height (feet).	Organisms and other matter (standard units per c. c.).											Volumetric data (c. c. per cubic meter).	
					Holophytic.			Holozoic.						Total plankton.	Amorphous matter and silt.		
					Diatoms.	Algæ.	Mastigophora.	Fungi.	Rhizopoda.	Ciliata.	Rotifera.	Crustacea.	Vermes, etc.			Total catch.	Plankton.
CINCINNATI DISTRICT.																	
August–October, 1914.																	
461	8	20.7	115	......	149 ba	56 cae	3	......	8	10 b	11 c	......	1	239	17,108	135	1.8
Little Miami River	6	......	40	6.1	34 bf	66 abc	14 d	......	8	18 e	40 ba	......	13	194	20,909	95.7	.87
Licking River	6	52	140	1.7	3	24 g	32 ce	......	29 a	9 h	63 b	6	1	165	29,817	60	.33
475	10	20.5	227	6.2	51 ba	41 cb	21	+	3	45 bch	66 ac	8	26	265	20,635	65.2	.87
Miami River	8	18	67	2.2	41 ag	95 abc	15 cf	2	2	15 db	......	38 a	15 a	225	28,340	102	.66
492	6	19	77.5	6.1	34 b	35 ca	7	......	2	29 bc	18 ca	18 a	1	143	16,625	85.75	1.34
November, 1914–January, 1915.																	
461	12	5.4	44	17.6	396 bce	15 be	27 b	......	......	17 c	23 cf	......	......	478	80,129	172.6	2.4
Little Miami River	11	......	190	8	216 fcgh	17 ae	3	1	10 a	2	......	......	12 a	264	80,306	221.5	.71
Licking River	10	7	166	45	66 a	15 ae	14 e	+	4 a	1	8	......	29 ab	138	171,080	308	.27
475	14	4	190	17.3	470 bce	103 ce	20 e	1	8 b	8 ac	15 a	......	12 a	630	208,232	456.5	2.32
Miami River	6	1	27	3.7	79 a	10 e	5	......	1	7	25 c	......	3	130	57,762	177.5	.42
492	13	5	210	17.7	532 bfc	60 ec	31 e	+	......	16 b	29	......	83 a	753	114,587	439	10.65
February–March, 1915.																	
461	8	4	......	......	44 c	5	1	6	7 a	4	10	......	27 a	105	46,087	191	.39
Little Miami River	8	4	83	8.9	20 cj	10 e	2	......	14 a	8 ba	24 b	......	18 a	95	52,062	173.5	.47
Licking River	9	......	154	5.4	10 ac	5 h	1	1	4 a	2	3	......	32 a	58	58,859	172.5	.21
475	9	4	130	261	25 a	8	......	1	4	3 a	11 bd	9 a	36 a	94	81,622	175.8	.32
Miami River	9	5	31	5.3	43 a	6	1	2	8 a	19 hcj	1	......	28 ac	108	103,044	246	.48
492	9	3.5	103	27.9	31 aj	18 e	......	3	15 a	11	6	2	23 a	105	102,900	279.5	.28
April–May, 1915.																	
461	8	15.5	24	......	502 ef	8 c	26 be	......	6	11 ba	62 ca	......	1	617	35,593	102.6	1.64
Little Miami River	7	17	......	6.2	800 fbj	59 ced	76 fd	......	7 c	38 fg	86 ba	......	6	573	16,286	81.1	2.8
Licking River	7	......	164	3.1	79 fa	40 gc	80 f	......	6	14 b	145 afb	......	28 a	394	111,000	211	1.01
475	7	15	35	12	319 bce	14 ca	9 cf	3	4	17 ab	7 c	......	14	388	17,614	62.2	1.36
Miami River	8	16	29	......	1,143 fce	207 cbj	32 fc	4	8	15 a	118 baf	10 a	24 ac	1,561	42,862	118.2	4.72
492	8	15	119	12.6	469 cbe	46 ec	14	......	29 a	40 hb	25 ac	8	18	658	104,100	187	.18

June–July, 1915.																	
461	10	22	......	......	31 f	22 aecf	7 e	2	29 ae	33 bd	15 c	......	57 a	194	319,298	823	.46
475	9	28	401	16	22 k	29 eac	25 ec	2	35 ab	65 bda	11	5	21 a	213	222,022	685	.65
Miami River	5	......	......	......	5	19 b	3	......	52 a	41 b	18 c	1	20 a	159	250,200	767	.49
492	9	23	668	17.3	17 k	19 c	14 e	3	19 a	20 ab	34 c	......	18	144	323,511	888	.42
LOUISVILLE DISTRICT.																	
September–October, 1914.																	
598	9	21	71	5.4	21 b	68 a	1	......	+	24 b	109 ca	75 a	19	319	6,959	38.7	2.36
619	17	20	89	5.2	28 b	88 ac	49	2	3	29 b	44 c	3	7	252	9,052	894	1.48
November, 1914–January, 1915.																	
598	14	5	239	18.1	422 bcj	28 afc	32 e	4	29 a	161 b	35 bcd	2	21 a	734	171,402	546.5	3.76
619	24	19	23	16.5	464 bea	34 ea	46 de	+	44 a	10 b	23 ab	3	13 a	638	167,999	450	2.52
February–March, 1915.																	
598	9	4.3	148	26	21 a	3	13 e	......	47 a	1	1	......	36 a	124	146,511	336	.3
619	18	4	150	20.9	22 a	2	5	......	38 a	3	......	......	38 a	109	77,843	301.5	.42
April–May, 1915.																	
598	61	5	17	10	175 ae	25 b	13 f	1	2	8 b	17 c	......	1	243	9,258	44.9	1.21
619	8	14	22	10	248 bae	32 cad	13	......	8	12 b	16 a	......	9	339	11,825	52.5	1.44
June–July, 1915.																	
598	9	24.5	260	161	7	8	5	......	44 a	22 b	15 c	6	18 a	125	143,655	534	.48
PADUCAH DISTRICT.																	
September–October, 1914.																	
904	5	23	100	......	31 b	60 ac	......	......	......	10 b	90 ca	40 a	1	235	14,700	50.5	.87
Cumberland River	4	24	199	......	1	15 e	4	......	20 a	37 d	22 a	......	3	101	11,550	41.2	.3
920	9	23	109	......	47 ba	41 ab	+	......	30 a	37 d	94 a	38 ad	+	289	14,522	47.8	1.08
Tennessee River	6	25	82	......	10	6	2	......	8	37 bd	1	......	3	67	14,050	40.5	.19
926	4	24	132	......	32 ak	32 ab	1	......	12 a	21 b	37 a	......	......	134	12,300	37.4	.4
933	10	23	123	......	20 b	38 a	......	......	10	38 bd	42 a	20 c	4	173	13,820	42.7	.48

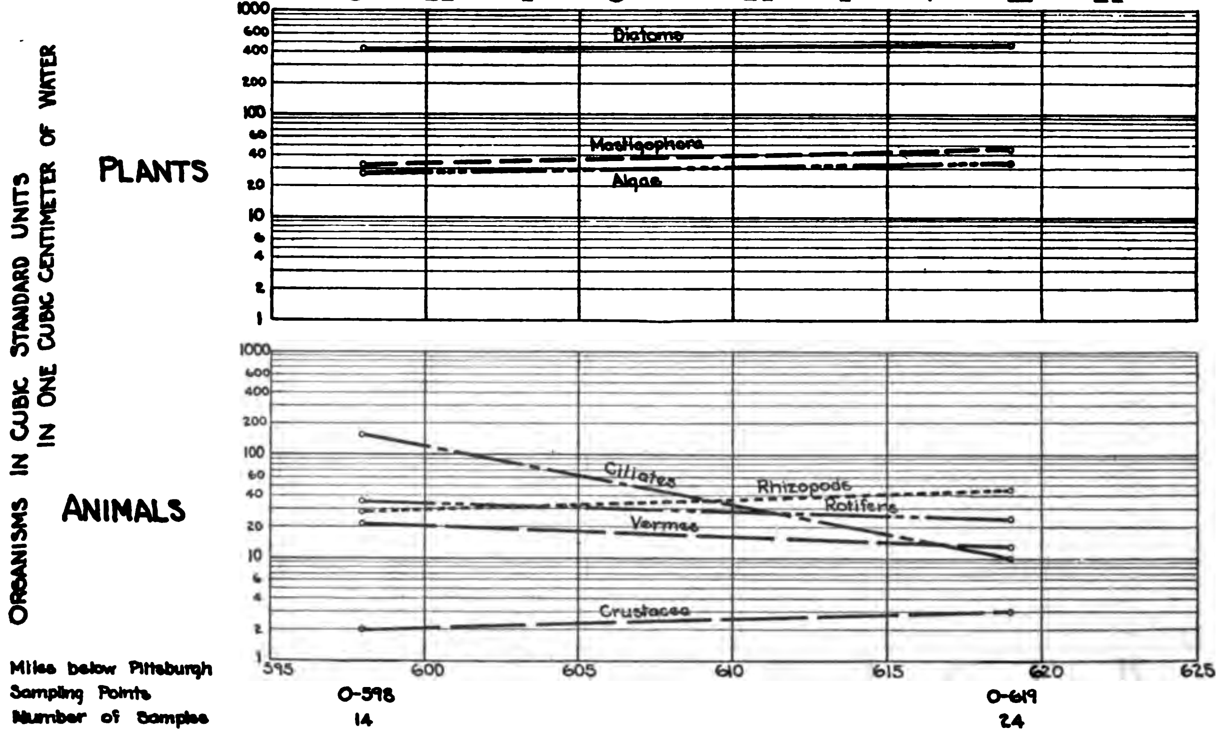
PLANKTOGRAPH No 9 LOUISVILLE DISTRICT SEPTEMBER—OCTOBER 1914

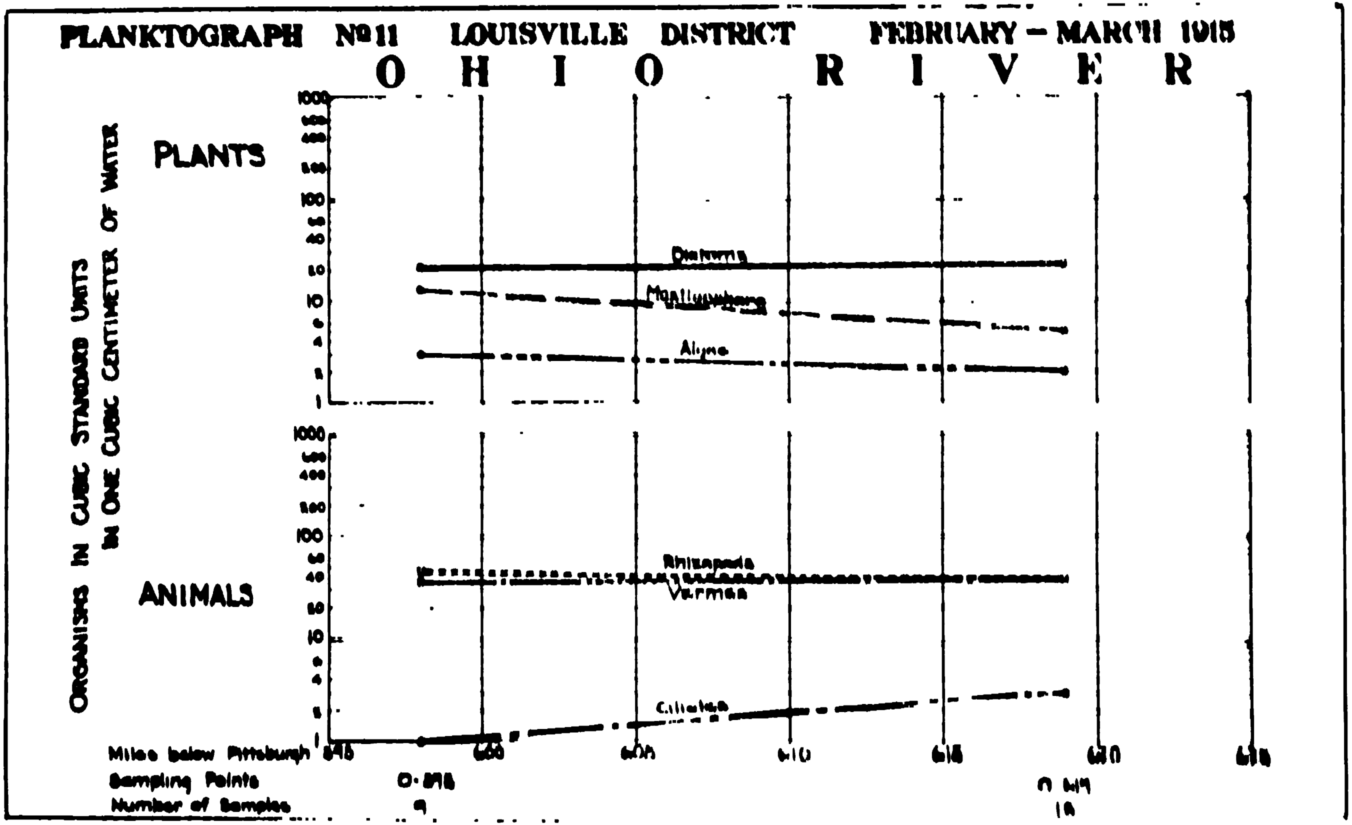
O H I O R I V E R



PLANKTOGRAPH Nº 10 LOUISVILLE DISTRICT NOVEMBER 1914 – JANUARY 1915

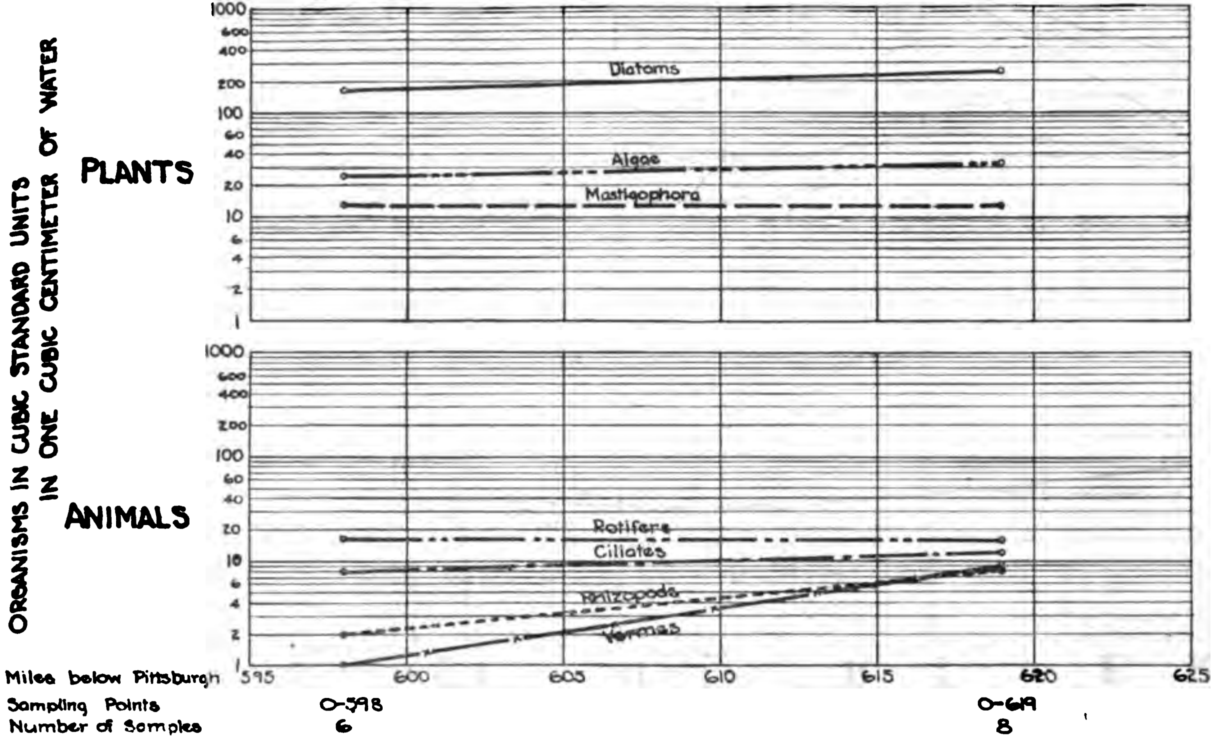
O H I O R I V E R

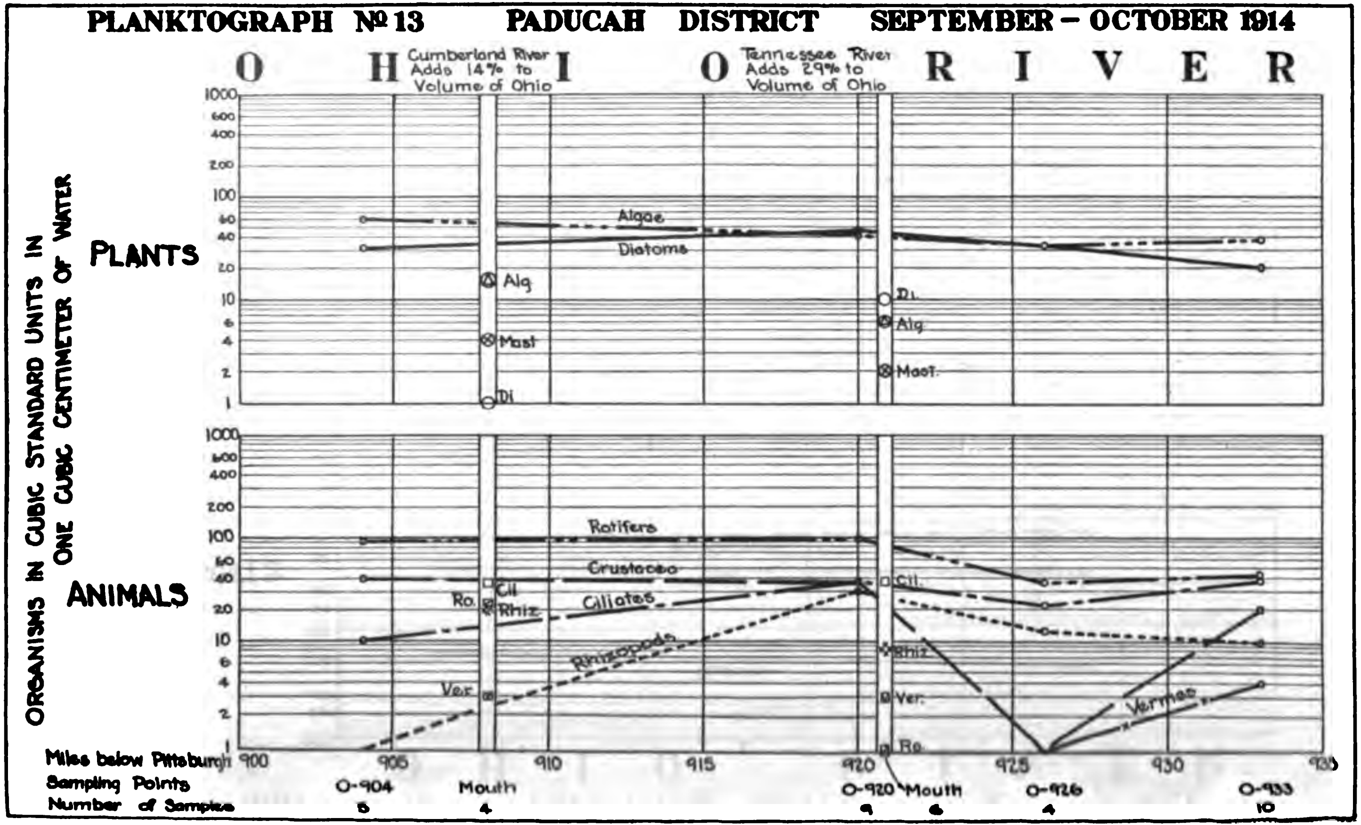



PLANKTOGRAPH Nº 11 LOUISVILLE DISTRICT FEBRUARY – MARCH 1915
OHIO RIVER
ORGANISMS IN CUBIC STANDARD UNITS IN ONE CUBIC CENTIMETER OF WATER
PLANTS
ANIMALS
1000
600
400
200
100
60
40
20
10
6
4
2
1
Diatoms
Mastigophora
Algae
Rhizopoda
Vermes
Ciliata
Miles below Pittsburgh 595 600 605 610 615 620 625
Sampling Points O-598 O-619
Number of Samples 9 18

PLANKTOGRAPH №12 LOUISVILLE DISTRICT APRIL – MAY 1915

OHIO RIVER





PLANKTOGRAPH No 13 PADUCAH DISTRICT SEPTEMBER – OCTOBER 1914

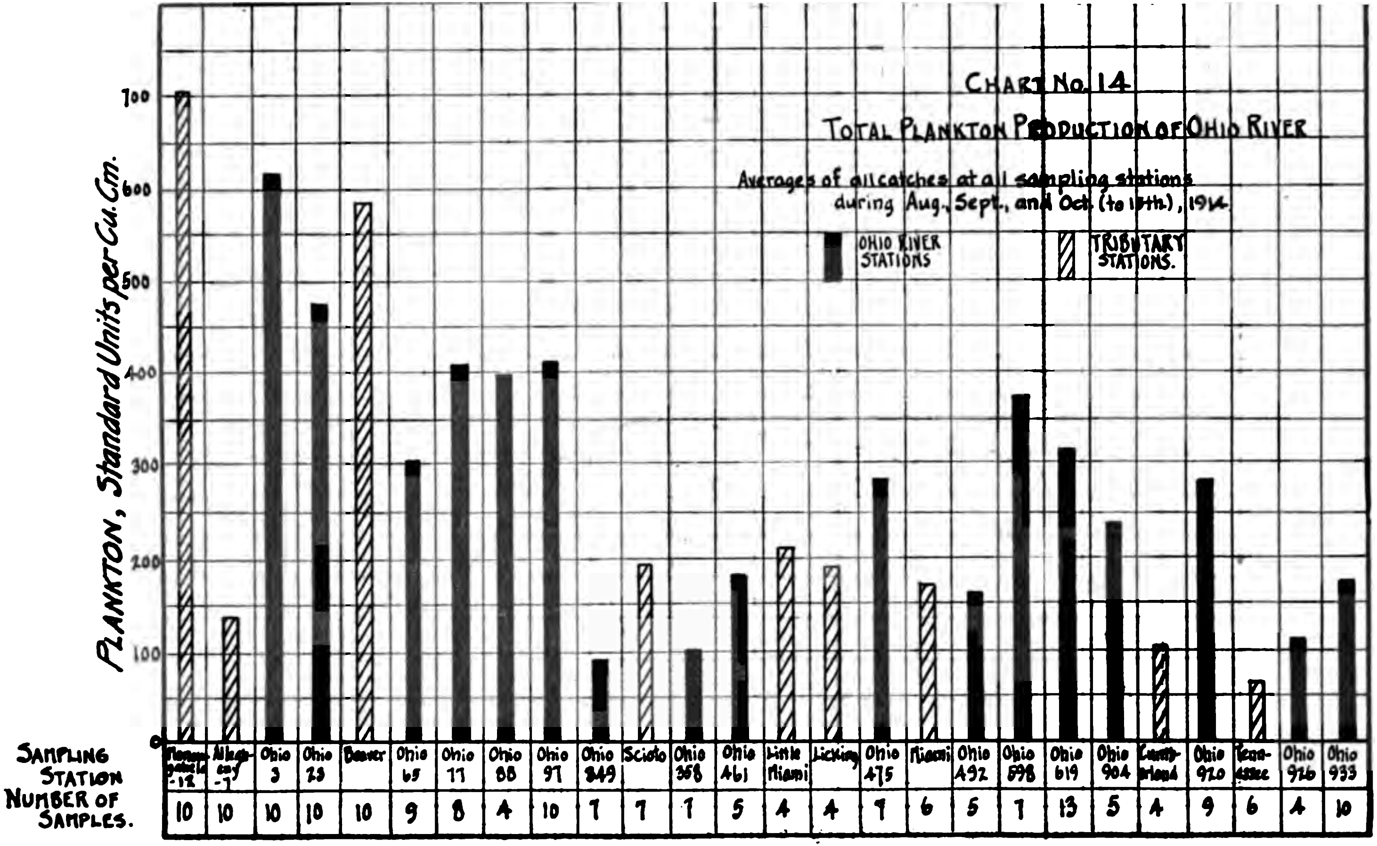
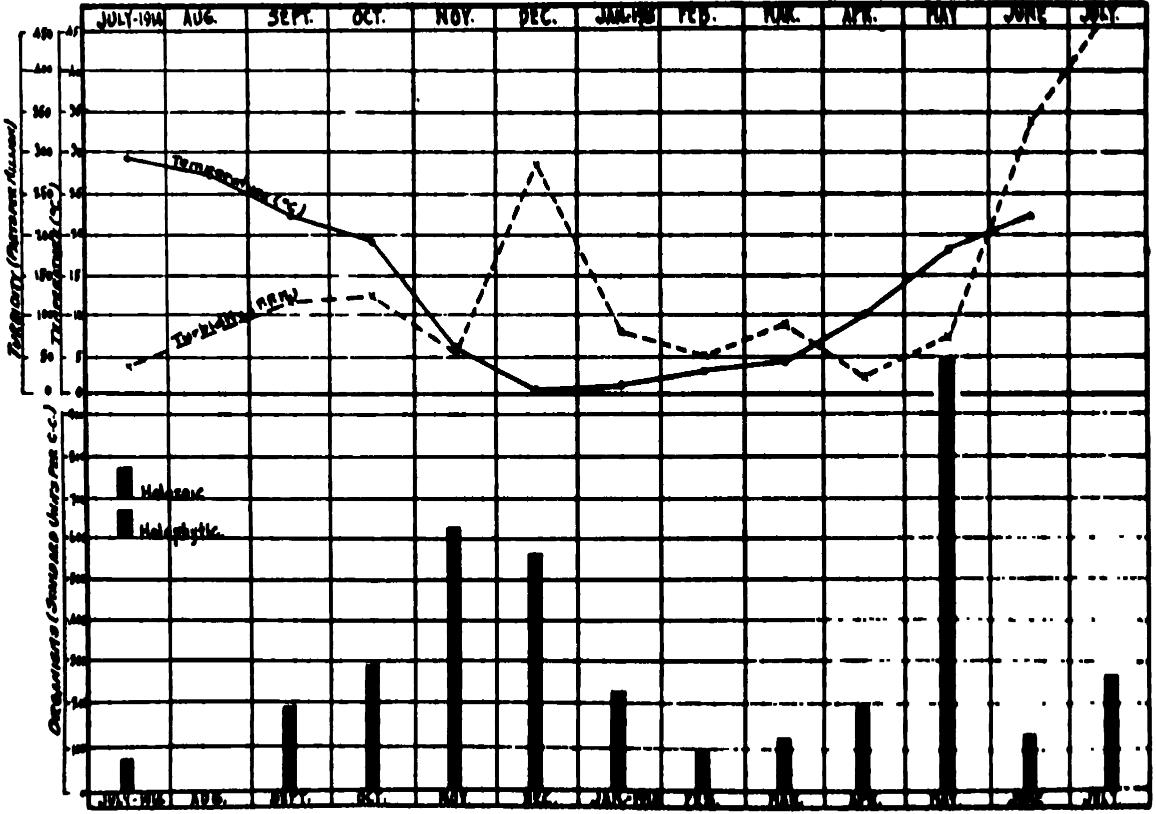


CHART No. 14

TOTAL PLANKTON PRODUCTION OF OHIO RIVER

Averages of all catches at all sampling stations during Aug., Sept., and Oct. (to 15th), 1914.

CHART NO. 15 – SEASONAL DISTRIBUTION OF PLANKTON AT STATION 461 – Monthly Averages, July, 1914–July, 1915.



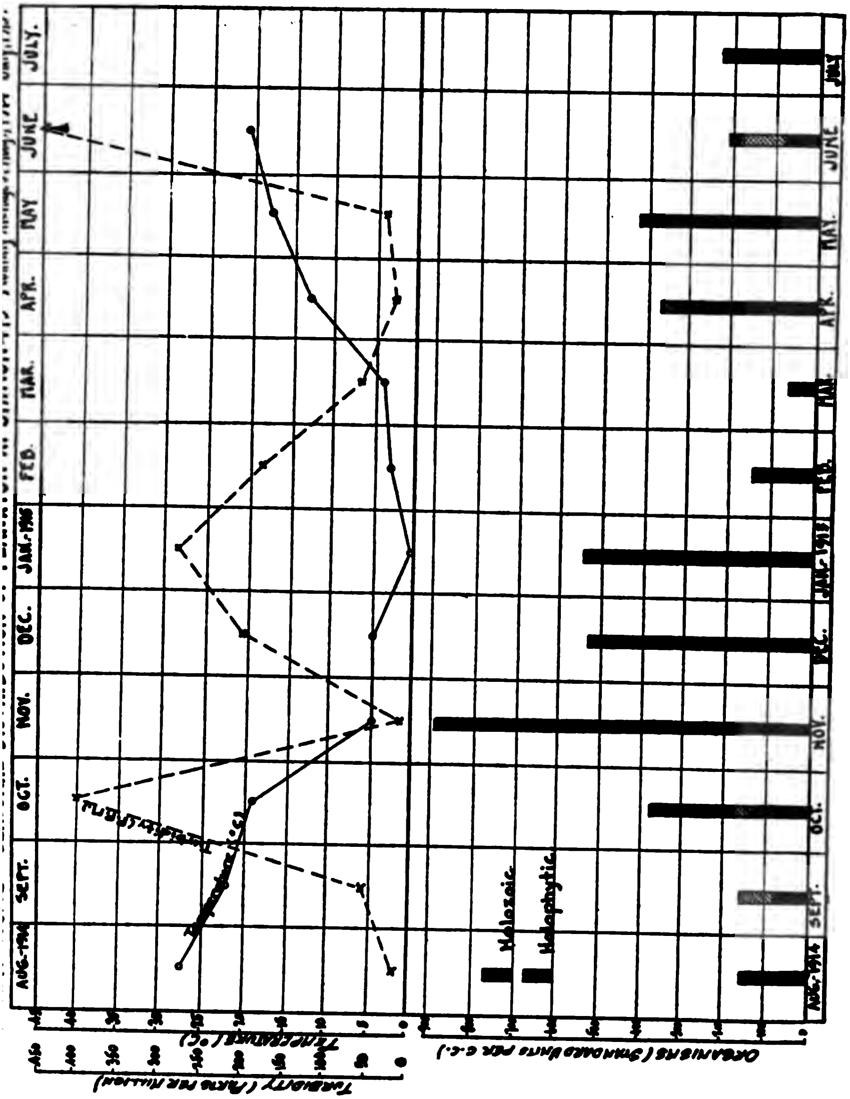

AUG.-1914
SEPT.
OCT.
NOV.
DEC.
JAN.-1915
FEB.
MAR.
APR.
MAY.
JUNE
JULY.
Turbidity (P.P.M.)
Temperature (°C)
Holozoic
Holophytic
0
5
10
15
20
25
30
35
40
45
TEMPERATURE (°C.)
0
50
100
150
200
250
300
350
400
450
TURBIDITY (PARTS PER MILLION)
ORGANISMS (STANDARD UNITS PER C.C.)

CHART NO. 17

HYDROGRAPHIC CURVES SHOWING SEASONAL FLUCTUATIONS IN DISCHARGE, THOUSAND SECOND FEET, OF LITTLE MIAMI AT PLAINVILLE, O., LICKING AT FALMOUTH, KY., AND OHIO AT CINCINNATI

Period from July, 1914 to December, 1915.

PERIOD I: Unusually Stable Flow.
PERIOD II: Unusually Unstable Flow.
PERIOD III: Normal Flow

Note: Vertical discharge scale for Little Miami and Licking amplified to ten times corresponding scale for Ohio

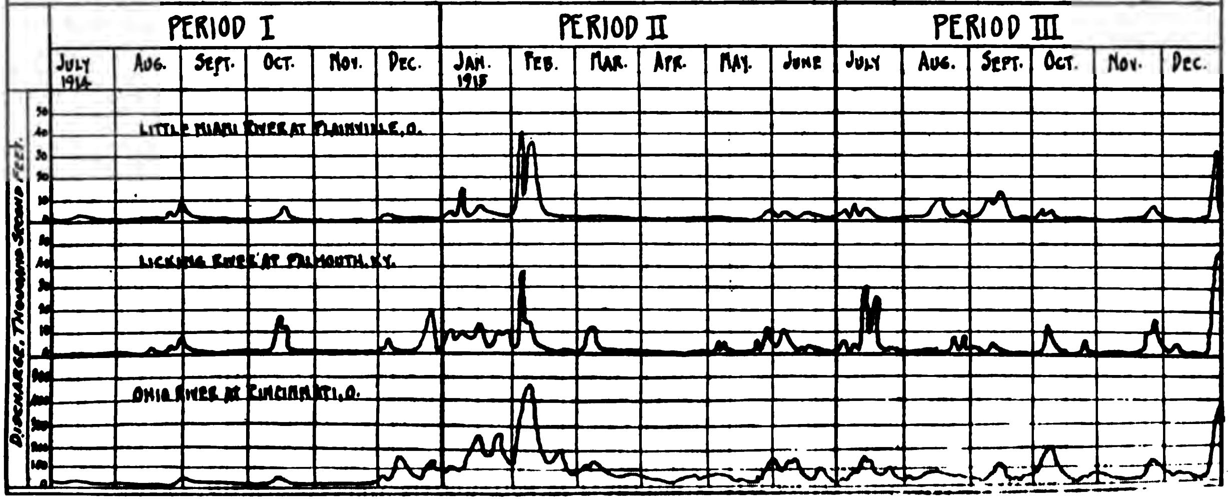
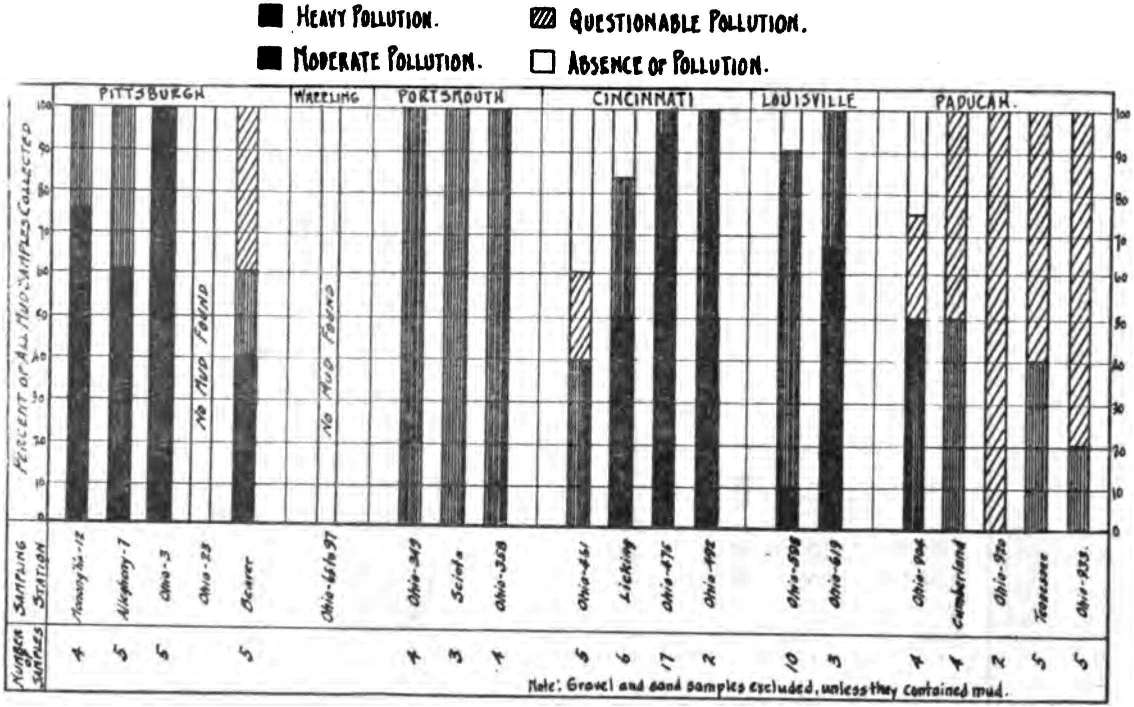


CHART NO. 18

SANITARY STATUS OF OHIO RIVER AS SHOWN BY THE PHYSICAL CONDITION AND THE ORGANISMS OF BOTTOM DEPOSITS.

COLLECTED AUG. 1 TO OCT 15, 1914



Note: Gravel and sand samples excluded, unless they contained mud.

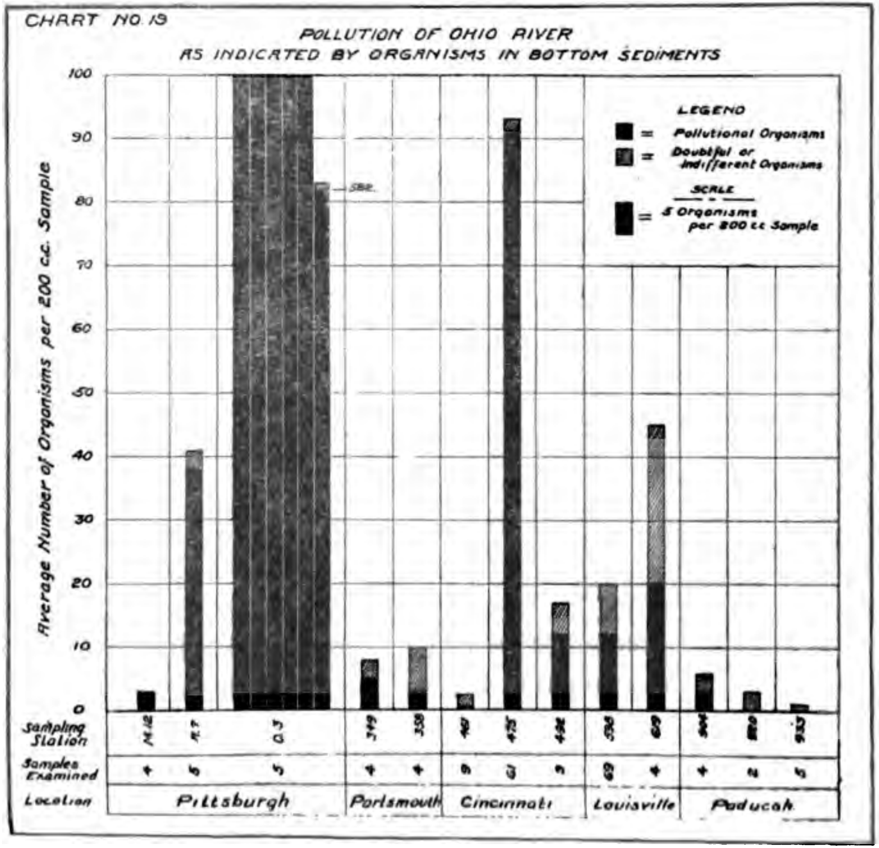


CHART NO. 19
POLLUTION OF OHIO RIVER
AS INDICATED BY ORGANISMS IN BOTTOM SEDIMENTS
Average Number of Organisms per 200 c.c. Sample
100
90
80
70
60
50
40
30
20
10
0
LEGEND
■ = Pollutional Organisms
▨ = Doubtful or Indifferent Organisms
SCALE
■ = 5 Organisms per 200 c.c. Sample
588
Sampling Station
M.12
R.7
O.3
349
358
461
475
492
596
619
904
880
933
Samples Examined
4
5
5
4
4
9
13
9
69
4
4
2
5
Location
Pittsburgh
Portsmouth
Cincinnati
Louisville
Paducah

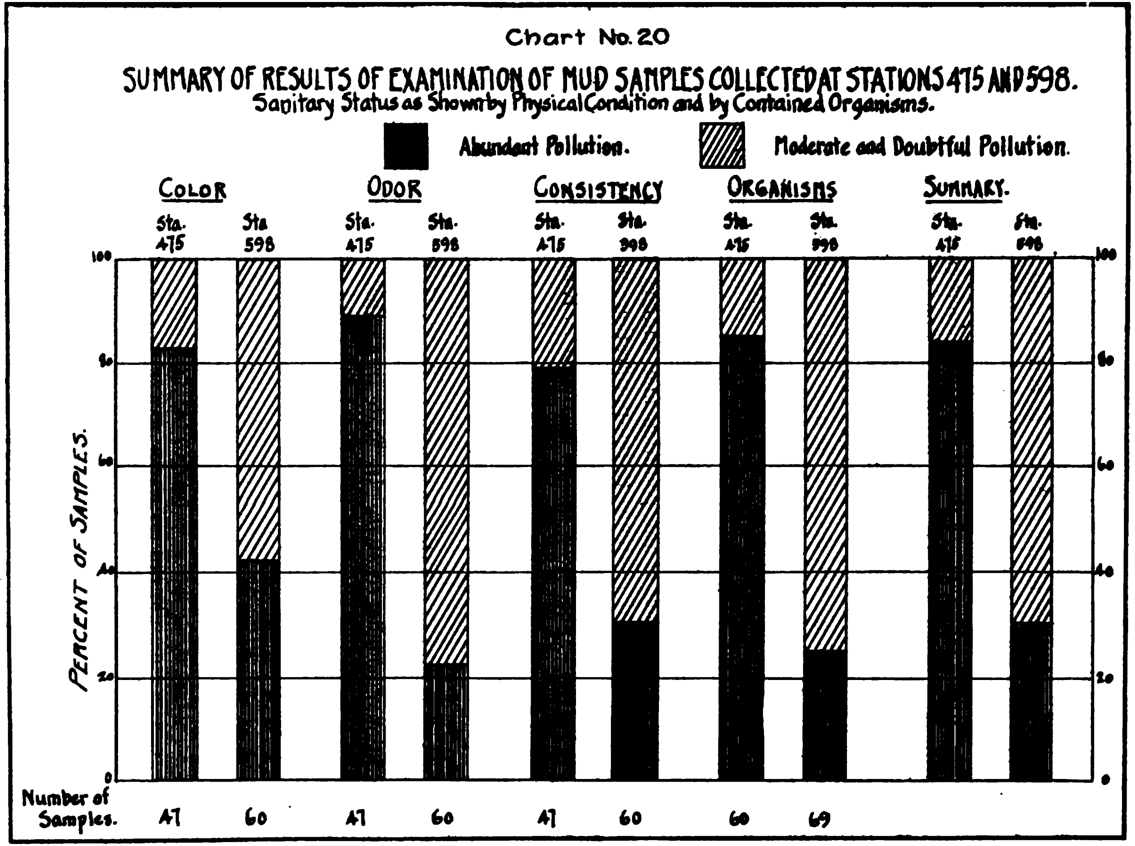


Chart No. 20

SUMMARY OF RESULTS OF EXAMINATION OF MUD SAMPLES COLLECTED AT STATIONS 475 AND 598.
Sanitary Status as Shown by Physical Condition and by Contained Organisms.

RELATED PUBLICATIONS.

Available reprints and bulletins on stream pollution, issued by the Public Health Service, from which copies may be obtained without cost:

PUBLIC HEALTH BULLETIN.

No. 74. Investigation of the pollution of tidal waters of Maryland and Virginia, with special reference to shellfish-bearing areas. By Hugh S. Cumming. 1916.

No. 86. Investigation of the pollution of certain tidal waters of New Jersey, New York, and Delaware, with special reference to bathing beaches and shellfish-bearing areas. By Hugh S. Cumming. 1917.

No. 87. Stream pollution. A digest of judicial decisions and a compilation of legislation relating to the subject. By Stanley D. Montgomery and Earle B. Phelps. 1917.

No. 97. Studies on the treatment and disposal of industrial wastes: I. The treatment and disposal of strawboard waste, by Harry B. Hommon. II. The determination of biochemical oxygen demand of industrial wastes and sewage, by Emery J. Theriault and Harry B. Hommon. 1918.

No. 100. Studies on the treatment and disposal of industrial wastes: III. The purification of tannery wastes, by Harry B. Hommon. (Final report.) 1919.

HYGIENIC LABORATORY BULLETIN.

No. 104. Investigation of the pollution and sanitary conditions of the Potomac watershed, with special reference to self-purification and the sanitary condition of shellfish in the lower Potomac River. By Hugh S. Cumming. Plankton studies by W. C. Purdy and hydrographic studies by Homer P. Ritter. 1916.

REPRINTS FROM PUBLIC HEALTH REPORTS.

No. 214. Studies on the self-purification of streams. By Earle B. Phelps. August 14, 1914.

No. 362. The sewage pollution of streams. By W. H. Frost. September 15, 1916.

No. 384. Control of pollution of streams. The International Joint Commission and the pollution of boundary waters. By Earle B. Phelps. January 26, 1917.

No. 581. Prevention of stream pollution by dye and intermediate wastes. By E. J. Casselman. January 23, 1920.

ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
15 CENTS PER COPY

PURCHASER AGREES NOT TO RESELL OR DISTRIBUTE THIS
COPY FOR PROFIT.—PUB. RES. 57, APPROVED MAY 11, 1922